Smithsonian Library

JOURNAL OF MAMMALOGY

VOL. 18 FEBRUARY, 1937 NO. 1

AMERICAN SOCIETY OF MAMMALOGISTS

The American Society of Mammalogists

Founded April 3, 1919
Incorporated April 29, 1920

H. E. Anthony, *President*
Joseph Grinnell, Edward A. Preble, *Vice-Presidents*
Robert K. Enders, *Recording Secretary*
William H. Burt, *Corresponding Secretary*
Miss Viola S. Schantz, *Treasurer*
A. Brazier Howell, *Chairman, Editorial Board*

Additional Directors

1935–1937	1936–1938
Harold J. Coolidge, Jr.	Chas. C. Adams
William J. Hamilton, Jr.	Rudolph M. Anderson
Arthur H. Howell	Lee R. Dice
Remington Kellogg	W. K. Gregory
W. E. Saunders	H. H. T. Jackson

C. Hart Merriam
Wilfred H. Osgood
Glover M. Allen
Witmer Stone
Marcus W. Lyon, Jr.
Vernon Bailey
} Past-Presidents

Trustees

W. K. Gregory (1934) H. E. Anthony (1935) W. Reid Blair (1936)

Standing Committees

Editorial: A. Brazier Howell, *Chairman.* A. H. Howell, Remington Kellogg, Edward A. Preble, Wm. L. Straus, Jr., G. H. H. Tate.

Life Histories and Ecology: W. J. Hamilton, Jr., *Chairman.* E. A. Goldman, V. H. Cahalane, C. E. Johnson, E. Raymond Hall, O. J. Murie, Robert T. Hatt.

Anatomy and Phylogeny: T. Wingate Todd, *Chairman.* W. K. Gregory, Carl Hartman, Adolph H. Schultz, George B. Wislocki.

Bibliography: Gerrit S. Miller, Jr., *Chairman.* C. Lewis Gazin, Arthur J. Poole, Arthur Svihla, William L. Straus, Jr., G. K. Noble.

Marine Mammals: T. S. Palmer, *Chairman.* Glover M. Allen, Remington Kellogg, Gerrit S. Miller, Jr.

Economic Mammalogy: Adolph Murie, *Chairman.* Stanley G. Jewett, George M. Wright, Joseph Dixon, Charles E. Johnson, Otto W. Geist, Paul F. Hickie.

Conservation of Land Mammals: W. E. Sanderson, *Chairman.* Edward A. Preble, Arthur N. Pack, Francis Harper, Ben H. Thompson, W. E. Saunders.

Nomenclature: Wilfred H. Osgood, *Chairman.* Glover M. Allen, Arthur H. Howell, Gerrit S. Miller, Jr., T. S. Palmer, George Gaylord Simpson.

Membership: William P. Harris, Jr., *Chairman.* Seth B. Benson, Victor H. Cahalane, Colin C. Sanborn, George H. H. Tate, Rudolph M. Anderson.

The Journal of Mammalogy

Subscription rates, $4.00 per year; single numbers $1.00 each. Sent free to all members of the American Society of Mammalogists not in arrears for dues.

Subscriptions, changes of addresses, requests for missing numbers, applications for advertising rates, etc., should be sent to the corresponding secretary, William H. Burt, Museum of Zoology, University of Michigan, Ann Arbor, Mich.

Manuscripts for publication, books and papers for notice and reviews, etc., should be sent to A. Brazier Howell, Department of Anatomy, Johns Hopkins Medical School, Baltimore, Md.

Entered as second-class matter, November 22, 1919, at the Postoffice, Baltimore, Md., under the act of March 3, 1879.

Made in United States of America

JOURNAL OF MAMMALOGY

Published Quarterly by the American Society of Mammalogists

VOL. 18 FEBRUARY 14, 1937 No. 1

NOTES ON THE BEAVERS OF WOOD BUFFALO PARK, ALBERTA

BY J. DEWEY SOPER*

Even in a territory richly endowed with wild life, no mammal provides a greater fund of interest for the traveller than the Canadian beaver. To those fortunate enough to visit northern solitudes, his works and ways are a source of perpetual fascination; no matter how commonly distributed and familiar in the day to day program of activities, the species captivates with an almost constant variation of engineering skill, neither surfeiting with the commonplace, nor dulling interest with immutable method. For this reason life history studies may continue for a long time without essential duplication or exhaustion. Especial interest attaches to the life of *Castor c. canadensis* in the more northern latitudes, where it has received little specialized attention, except from the fur trade.

Despite its relatively high northern position, Wood Buffalo Park embraces large areas ideal for beaver. Lakes, ponds, and sluggish streams are numerous, and food trees plentiful. The territory of 17,300 square miles lies entirely within the Canadian Zone, and largely at elevations between 700 and 1000 feet. Extensive valleys and uplands are clothed with luxurious forests of white spruce, jack pine, birch, aspen, and balsam poplar. In addition, most of the lakes and streams are flanked with a wealth of alders and various species of willows. In consideration of latitude, to many it is surprising to learn that soil and climatic conditions are such that in favorable locations white spruce frequently attains a diameter of two feet, balsam poplar 30 inches, and trembling aspen 12 to 15 inches. The latter is the principal food tree of beavers in this country, while next in order of choice, or availability, are white birch, balsam poplar, willows, and alders, and rarely conifers.

The hurried voyageur on such principal streams as the Athabaska, Peace, and Slave rivers will note little or no sign of beavers along the banks. Conditions along the larger rivers normally are not attractive to beavers, with the

* Published with the permission of Department of Mines and Resources, Ottawa, Canada.

broad expanse of waters and the swift pace of the current, although food trees may be plentiful. Over very extensive areas immediately adjacent, conditions are radically different, and in suitable locations beavers abound. Occupied lakes and ponds are legion and some of the most insignificant of streams are turned to account by one or more families of these industrious animals.

During the course of my investigations in the park wilderness from 1932 to 1934, exceptional opportunities were presented for observation both in winter and in summer. The latter season is naturally superior in many respects, but much can be learned during the colder months. Although the country throughout is in the Canadian Zone, local conditions vary markedly from place to place. It is most interesting and instructive to note how the animals in their wide-spread occupation of the region meet these various physiographic and floral conditions as they depart from ideal, or what may be regarded as normal characteristics. It follows that the species is much more abundant in some sections than in others.

In the alluvial lowlands bordering the main waterways, including the Slave River and the Peace-Athabaska deltas, beavers are scarce or entirely wanting. Over the forested plains in the eastern sector of the park, at elevations between 700 and 800 feet, occupation is greater, but the bulk of the population centers in the Alberta plateau sector, with its average elevation of about 950 to 1000 feet. This cradles an extravagant array of lakes, ponds, and streams; a large number of these are ideal and attract beavers in considerable abundance. The better beaver waters, as represented by Pine and Flatgrass lakes, are bordered by extensive stands of aspen poplar (*Populus tremuloides*). In many cases the woods are composed of pure stands of this tree and superficially resemble tracts in the Transition Zone of the central parts of the prairie provinces. Growth is comparatively rapid in this region, with 18 to 20 hours of daylight during summer, and in consequence poplars and willows tend to occupy denuded tracts at a rate sufficient to balance beaver consumption. Only in rare instances throughout this country does a tract of beaver-felled trees attract particular attention. Such operations are gradual and relatively imperceptible.

An abundance of beaver sign and many animals were seen on Net River; Buffalo River as far as it was ascended to the forks in latitude 59°55′; along Copp Creek; throughout the length of Little Buffalo and, to a lesser degree, Salt rivers. Fair numbers also inhabit Nyarling, Klewi, Sass, and Jackfish rivers and their tributaries. Of these, the most notable is the upper length of Little Buffalo River on the Alberta plateau. While this stream has a relatively rapid descent from its source at Thultue Lake, with innumerable rapids and riffles, sluggish intervals are equally numerous. The beavers have ideally adapted the stream to their requirements by the construction of scores of dams, many of which are placed directly on the site of the smaller rapids, thus increasing the area of the naturally quiet stretches above them.

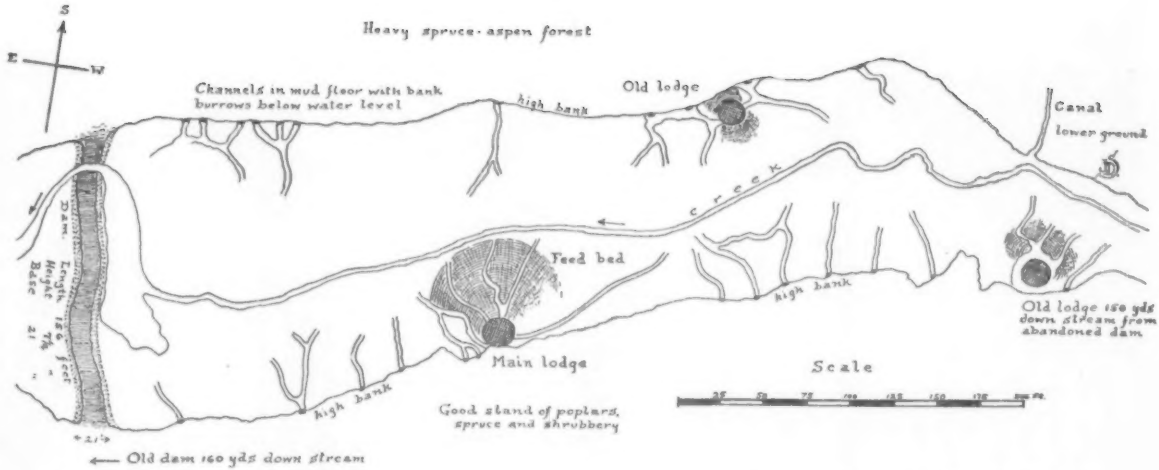


FIG. 1. Plan of an abandoned and drained beaver pond on a small tributary of Salt Creek, 21 miles west of Slave River.

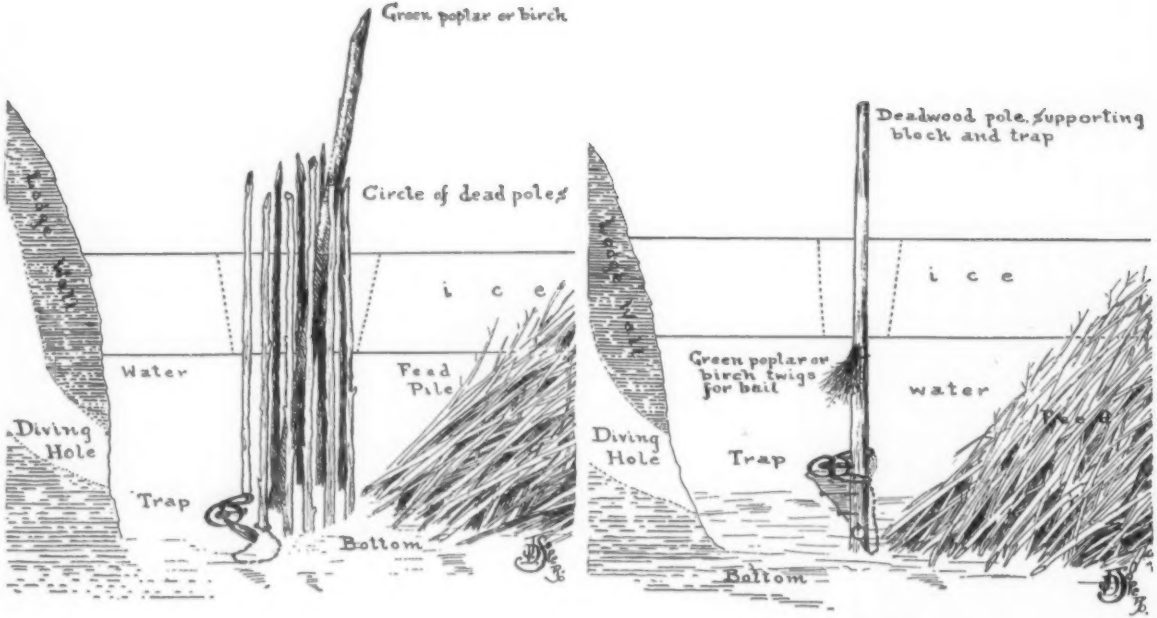


FIG. 2 FIG. 3

FIG. 2. Plan of the method of trapping beavers most commonly used by the Indians of Wood Buffalo Park; to the left. FIG. 3. The under-ice method of trapping most popular among the white and half-breed trappers; reputedly more successful; to the right. Drawings adapted from M. J. Dempsey.

In this manner, also, numerous rocky and shallow white-water parts of the stream have been flooded, providing perfect canoe navigation where formerly this was difficult or impossible. The same applies to many other streams, incidentally assisting the members of the warden service and other travellers. Below the falls of the Little Buffalo, where the stream skirts the Alberta plateau escarpment as it meanders through the Slave River lowlands north to Great Slave Lake, beavers are much less numerous.

The beaver population of the stream, however, is only a part, and evidently the smaller part, of the picture. Hundreds of ponds and lakes have a comparable abundance. These, as pointed out, exist in prodigal profusion over the western part of the park. This is particularly pronounced in a sweeping semicircle east of Caribou Mountain, from Peace River northward to Conibear and Thultue lakes, and on northwest to Buffalo and Copp lakes. Personal observation, together with information from the Indians about territory not included in the writer's explorations, indicate a consistent spread of population over the vast area in question. In speaking of the wonderful wealth of beaver life on Little Buffalo River, the Indians of Sucker Creek and Salt River settlement referred to the abundance of beavers in adjacent lake-sprinkled territory in even more glowing terms.

According to my experience, there is scarcely a lake worthy the name and with suitable surroundings but has one or more beaver lodges, while others, which one would regard as distinctly unsuitable, likewise are occupied. Pine Lake, for example, supported five, while every one of the small lakes of the chain extending southward had one or more lodges. Ten were noted along the northeast arm and west shore of Conibear Lake; three in Lake Seven; five in Lake Six. We were informed by an Indian trapper of the locality that Lake Four contained 15 lodges, from which he and his son easily trapped their quota of 30 beavers in the spring of 1932, leaving an ample number for breeding; this little lake has an area of only 10 to 12 square miles. In a small lake south of Pine Lake with only two lodges, Chief Warden M. J. Dempsey and I observed 14 beavers during the early twilight of a June evening in 1932.

Of all the parts of the park visited, the greatest concentration of beavers personally observed was along Little Buffalo River from Thultue Lake to the canyon in the Northwest Territories. In this distance—a matter of some 130 miles by river course—110 dams and 95 lodges were counted. The latter accommodated only a portion of the river population, as numerous stretches with relatively high banks and abundant beaver signs were observed, which were without visible lodges. Here the animals obviously lived in the banks. A conservative estimate would be 1000 beavers in this length of river.

A notable characteristic over long distances was the regularity with which one lodge occurred at each dam. At irregular intervals an area of pond was occupied by two, indicating affiliation of two families (probably 10 to 14 animals) at a single dam. What with deep holes behind small rapids where

dams were constructed, there was no necessity for building the dams very high, and the average height was about two and one-half feet. The very low gradient of the stream in places resulted, even with a two-foot dam, in forming a pond with a length of many hundred yards. As the result of a low dam, 150 yards long, spanning the stream and low alluvial lands in the valley west of Ninishith Hills, abnormal water-level was noted above the structure for a distance of fully two-thirds of a mile. Two lodges were present here, one of which was built into and acted as a portion of the dam. Great activity reigned at this colony in late July. Trees and willows in abundance were being cut and transported, and the dam lengthened and raised with feverish vigor. When completed, the water doubtless would be backed up for at least a mile.

During the course of wild life inquiries many notable dams were encountered on Alberta plateau and at lower levels. The largest of these, as it happened, was an abandoned one on a small tributary of Salt Creek, near Cabin 11, about 21 miles west of Slave River. The reason for the withdrawal of this colony is unknown; the site apparently is ideal, with an adequate food supply. At present the south end of the dam is washed away by spring freshets and the former pond completely drained, exhibiting the details of the beaver works on bottom and sides. This was surveyed by the writer in September, 1933, with the results shown in figure 1. The main dam is 156 feet in length, 7.5 feet high, 21 feet wide at the base, and an average of about 12 feet along the crown. The bulk is enormous, with a mud and timber content of not less than 650 cubic yards. Lesser dams (also abandoned) are located up and down stream at distances of 333 and 160 yards, respectively.

One of the most curious building sites observed was that at twin sink-holes along the Conibear Lake trail, about 24 miles in an air-line west of Pine Lake. These sink-holes are caused by the underlying strata of gypsum-limestone being dissolved by subterranean streams, and by the following gradual subsidence of superimposed materials. Such depressions usually are funnel-shaped, and when holding water, form clear, blue ponds of considerable depth. In the present instance the beavers had taken possession of one sink-hole with a water-level 20 feet higher than its neighbor, and had constructed a short, low dam on the natural earth bridge between the two. It is difficult to understand the reason for this, as originally the water in the occupied sink-hole already was very deep, without visible inlet or outlet. It appears that the water-level in these unique basins remains relatively constant from year to year, except when there are temporary additions made during the spring run-off. Most of the park's celebrated sink-holes are rapidly drained through holes in the rock strata at the apex of the inverted cones and consequently are dry.

In recent years, at least, the beavers have become very active in numerous tiny creeks. Some of these are barely a foot or two in width with a steady,

FIG. 4

FIG. 5

FIG. 4. Beaver lodge at the west end of Conibear Lake, July, 1933. FIG. 5. Beaver dam about 100 feet in length, on a small creek near Slave River, September, 1933.

FIG. 6

FIG. 7

FIG. 6. A beaver lodge on Little Buffalo River, one mile east of Thultue Lake, March, 1934. FIG. 7. An Indian trap-set for beaver under the ice, 10 miles southeast of Sass Lake, March, 1934. Lodge at left.

although meager, flow, intersecting grass and willow areas of slight fall. Here the animals construct dams under the necessity of building them high and wide in order to secure sufficient depth of water for their needs, and to prevent freezing to the bottom. Under these conditions, a suitable winter environment can be gained only at the expense of unremitting labor throughout the summer and fall. Places were noted where the animals were obliged successively to lengthen and heighten the dam in order to conserve flow and achieve depth of water until the attenuated structure on the wings lead for long distances over low, hummocky ground among alders and willows. Some sites embrace few if any trees. In extreme cases, conditions are such as to render one very skeptical of the beavers' ability to achieve, under existent conditions, sufficient depth of water to prevent ice from forming to the bottom. Such a contingency in mid-winter of the far north undoubtedly would be disastrous.

Notwithstanding the abundance of poplars in the park as a whole, beavers occasionally resort to the bark of the white spruces along the streams. Obviously this is not done from necessity, when an ample supply of aspen, alder, and willow is available. Examples of this trait were observed on several occasions, the most outstanding being one on the bank of Little Buffalo River above the falls. Here the animals had completely girdled, for several feet above the ground, a number of white spruces as large as 8 inches in diameter. There was no sign of loose bark at the base of the trees and the white wood of the boles had not been touched. Circumstantial evidence clearly pointed to the conifer bark having been eaten for food. Scattered stands of poplar and birch existed in this vicinity.

Between Lynx and Crane lakes a lodge was observed in a muskeg pond where not a trace of the usual deciduous food trees existed. As well as could be determined under a mantle of snow, the beavers had constructed the lodge entirely with spruce, tamarack, and possibly some willow. Even the latter was very scarce in the immediate locality. The principal source of food was not ascertained. The wardens have mentioned similar cases in other parts of the park. Such beavers are not driven to this extremity by want, but possibly they are attracted merely by an unoccupied pond, without regard to a normal food supply. In this case the lodge was very small and probably was the work of young and rather inexperienced animals.

Many of the lodges reach extraordinary proportions, with diameters of as much as 12 or 14 feet, or even larger, and heights of 8 or 10 feet. Others, again, are not over half this size. The varying dimensions probably reflect the age and experience of the builders, or the number engaged for mutual protection in the construction of the lodge. Throughout the region, lodges are located in a variety of ways, depending upon conditions. One is prone to regard the lake lodge as typical, especially when unconnected with the shore. A high percentage of them are built in sloughs and ponds, often partially

among willows, or tamaracks in flooded areas. Always one side of the lodge must give access to deep water, so that the animals can dive below heavy ice. The food piles are located close to the lodges, and in the case of a community of individuals these frequently reach surprising proportions.

The remainder of the lodges are found in small rivers and creeks, customarily in association with a dam. Dam and house frequently are close together, or more rarely built as a unit; usually the house is situated some distance upstream from the dam. In the latter situation the house ordinarily is close to the shore, and in most cases is built partly upon the land. While descending Little Buffalo River there were noted many houses built entirely upon the shore close to the water. The entrance was through a bank tunnel, or tunnels, below water level. In every case such structures were located at narrow parts of the river, sometimes where chrubbery almost interlocked overhead, and usually in dense forest. Occasionally such a lodge is closely surrounded by trees, and even is built embracing them. Under similar environmental conditions many beavers live exclusively in bank dens.

It was observed that river beavers construct houses with every degree of modification between the simple bank den and the lodge isolated in the stream. Examples of the former were noted where a scanty mattress of limbs and mud had been disposed on the ground a few feet from the bank. Its purpose apparently was to cover a small cave-in of the dirt roof above the living quarters. Under similar conditions, again, a heavy, domed "half lodge" is erected, the lower portion represented by the river bank itself. Entrance, as usual, is effected through submerged tunnels driven through the earth and up to the occupied chambers. Feed beds are located in the water close by, the relationship being essentially identical with that obtaining between stores and lodge when these are away from the bank. The former types of dwellings in streams are possible only where there exist substantial banks flanked by deep water.

A conspicuous beaver feature in the northern forest is the presence of mud deposits on the banks where the animals are active. These ordinarily are round or oval, from a few inches to a foot or more in diameter, and several inches deep. Trappers regard them as "sign" stations. Writers have credited the beaver with depositing castoreum on these mud heaps, but I was unable to detect any odor of this at such deposits as were carefully examined. It may be that these happened to be very fresh without castoreum application, or older ones on which the musk had been dissipated. In all cases noted the "mud pies" were on low, grassy points, or near the end of "logging runs" close to water-level. In some sections these features are scarce, but they were quite commonplace along the upper length of Little Buffalo River in late July.

As will be gathered from an earlier statement, beavers are very active in building dams, even in mid-summer, and general repairs are made also in

July to structures damaged by spring floods. Although in some cases important works are commenced at an earlier date, it appears that major construction is conducted at this time or later in the season. Very pronounced activity prevails during late summer and fall when final touches are made to lodges and dams. At this season also an ample supply of food is deposited in the water for the winter. Ponds and lakes usually freeze over in this latitude during the second or third week of October, and external activity ceases at this time.

In the spring, beavers normally make no effort to escape the long confinement of winter quarters until the arrival of spring freshets, which finally displaces the thick ice. The melting of ice in the lakes takes place somewhat later. The river break-up occurs about May 10. On rare occasions, according to Indian report, odd beavers leave the lodges to forage in the deep snow of the adjoining forest. Very likely this refers to random instances in early winter, or in late spring.

On April 2, 1933, a beaver was seen swimming about in an open stretch of Little Buffalo River at the mouth of Sucker Creek. It is unusual to observe the animals at this time of year, as winter conditions still substantially persist, except for modified temperatures. It can occur only toward late winter where warm springs or strong currents induce open patches in the thick ice. I was informed of a peculiar episode by Victor Marie, a Salt River Settlement Indian. In late November, 1933, after the rivers and lakes had long since been sealed over, a family of beavers appeared in the deep snow south of Klewi Lake to cut alders and poplars for food. He is of the opinion that the animals were in desperate straits and starved out. This evidently was caused by the abnormal subsidence of the water in the occupied stream, which drained out of the channel-ways to the lodge and from around the food supply. This would permit the ice to settle solidly over the site and prevent access to stores. An occurrence of this sort probably is very rare.

In the early spring the Indians trap beavers by making sets under the ice near the lodges. This type of trapping entails an enormous amount of labor, but at this season the furs are at their best, and furthermore, when the animals are accessible under iceless conditions the season is closed. Details of this style of beaver trapping were secured with a view to acquainting naturalists with them, for the occasion may arise when the scientific collector will need a reliable method of obtaining specimens at this time of year. I am greatly indebted to Chief Warden M. J. Dempsey for clarifying the subject by means of sketches. Two methods are shown herewith.

Figure 2 illustrates the method more commonly used by Indians to trap beavers under the ice. A hole is chopped through the ice over a deep runway between lodge and feed pile, or slightly to one side, in an ample depth of water. A half circle of dry poles is planted firmly in the muddy bottom and a green pole wedged solidly in the circle. A number two and one-half or

three trap is firmly anchored to a deeply imbedded dry pole and set up on the bottom at the entrance to the semicircular enclosure. To secure the green pole, used as bait, the beaver is obliged to cut it top and bottom, and in attempting to do this within the cubby, is caught in the trap and is quickly drowned.

In figure 3 is seen the method most widely employed by white and half-breed trappers. The usual hole is sunk in the ice over a favorable spot as shown, and a strong dead pole driven into the bottom. The pole then is withdrawn, a block quickly nailed near the base, the trap set upon it, the springs secured with twine around the pole for stability with the chain well anchored, and a bunch of green poplar or birch twigs tied to the upright above the trap. The whole then is carefully lowered and pressed deeply into the hole previously made in the bottom. The ice hole freezes over, securing the top. This set is justly popular, as it is speedy and easy to prepare, and all the work is done in comfort without wetting the hands at freezing temperatures.

An effort was made to estimate the total beaver population of the park—admittedly a matter not to be readily nor accurately achieved. Although I was enabled to travel by various means over 8000 miles on park investigations, many large areas were not covered because of lack of time and the difficulties incident to travel in primitive country. I would hazard an estimate of at least 15,000 beavers for the park, however, a figure based on knowledge of various streams with estimated abundance, and the average frequency of occupied ponds and lakes in sectors known. Approximately one-half, or about 8000 square miles, is not adapted to beavers, owing either to unsuitable topography, as in the streamless, sandy pine uplands of the central interior, or to lack of food and building materials in the great delta lowlands, impoverished muskegs, and open grass plains.

Before the park was created by a Dominion Government Order-in-Council, in December, 1922, beavers were much scarcer than today. Under the protective measures subsequently enforced by a wise administration, the species has steadily increased. At the time of my residence within the park, reports of increase were frequently heard, and recent expansion in numerous localities was readily noted. Thus, in places where beavers had not been seen for a decade or more, they are now established in ponds and insignificant streams which ordinarily would be ignored by a smaller beaver population. Opportunities for such expansion is still great.

Under existing laws, resident Treaty Indians of the park area retain their trapping and hunting rights, subject to park game regulations. When the park was established, it was deemed necessary to adopt a closed season on beavers for a period of years in order to replenish the supply. The beavers responded rapidly to the protection afforded them, and in recent years a restricted open season has been established, during which residents, under

permit, may take 15 animals each year. The spring open season is at a time when the species can be taken only by means of under-ice methods of trapping. Many of the Indians fail to take full advantage of this periodic and lawful opportunity, so that the drain is much less than the legal possibility. The average annual catch (for such intervals as have been declared open) does not exceed 700 pelts, or approximately 5 per cent of the estimated total beaver population. The species continues to multiply with every probability of again attaining its primitive numbers. It is not unlikely that the total will eventually reach a figure of 75,000 to 100,000 animals, or even more. Under the Dominion Government's beneficial system of wild life preservation for the area, as administered by the Department of Mines and Resources, this and other game resources are assured gradual appreciation.

National Parks Bureau, Winnipeg, Manitoba.

NOTES ON THE GIANT PANDA

By W. G. Sheldon

The purpose of this paper is to place on record a few observations on the habits and occurrence of the giant panda (*Ailuropoda melanoleuca*) made by the author and Dean Sage, Jr. while on a collecting trip for the American Museum of Natural History in western China in 1934. On the whole, it was our experience that reports of the native hunters on the life history of the "Bei-Shung" were conflicting and unreliable. I have confined myself, therefore, almost entirely to observations made personally. Our expedition, composed of Mr. and Mrs. Dean Sage, Jr., Mr. T. D. Carter, and myself, was in giant panda territory from about September 15 to December 15.

The area in which this study was made is included within a 40 mile, quarter-circle radius west of the town of Tsochow on the Min River in western Szechuan. At this point, 10 miles south of Wenchwan, the Chengou River flows into the Min, and it is at the headwaters of the various tributaries of the former that the giant panda occurs. Its range is known to extend as far south as Yeh-Li, while northernward the limit is uncertain. Probably it continues 60 miles north of the Wenchwan region, and A. De C. Sowerby has reported evidence of giant pandas in the Tsin Ling Mountains of Shensi Province to the northeast.

Diet.—Not only is the giant panda entirely herbivorous, but it is known to live on the dwarf bamboo of the northeastern spur of the Himalayas to the exclusion of *all* other vegetable matter. This is not true in the case of its small cousin, the arboreal little panda (*Ailurus*). The food supply in the mountains of west Szechuan is inexhaustible. In every mountain valley is to be found a broad band of bamboo forest flanking the slopes with an average

elevation from 5000 to 10,000 feet. The growth is so dense that in most places it is difficult for a man to get through. Unlike the bear, which in early spring must often travel miles for its food, the panda never can feel the pangs of starvation.

To me this explains a great deal about the animal. My experience convinced me that the panda is an extremely stupid beast. On one occasion at a distance of 350 yards I observed two individuals on the edge of a bamboo jungle. Driven out by four dogs and warned by several high-powered bullets whistling about them, neither animal even broke into a run. The gait was a determined and leisurely walk. Again, Dean Sage and I observed another panda pursued by four dogs. In this instance he *walked* to within eight feet of Dean and was stopped only by bullets. He gave absolutely no evidence that he saw either of us, and seemed completely to disregard both the shots and the loud talking and shouts of a few minutes previous. During the course of tracking different animals for several miles I never saw a sign of one travelling faster than a walk.

The male panda shot by the Roosevelts, as well as the one shot by the Englishman, Capt. H. C. Brocklehurst (April, 1935) were both tracked in the thick bamboos and encountered at close quarters. This would be unlikely in the case of any other species of large mammal, for traveling through the thick bamboos is very noisy.

From these experiences I feel justified in stating that the panda is not alert. If its struggle for survival were as difficult even as that of the bear, this animal would of necessity have developed much keener hearing and smell. Food is all about the panda, and a sense of smell is not needed for its discovery.

Most interesting of all were observations made of the quantity of bamboo that a single animal will eat. We found giant panda eating not only the bamboo shoots, but the stalks and leaves of fully mature sprouts, often an inch and one-half in diameter. In the last weeks of October all fresh droppings were composed exclusively of leaves stripped from the stalks. Later, stalks and leaves, or stalks alone, were found in them. We can offer no plausible explanation for this variation in diet.

Captain H. C. Brocklehurst (Illustrated Sporting and Dramatic News, vol. 148, no. 3237, p. 608, 1935), made the following statement: "The male eats stalks up to an inch or more in diameter, while the female eats only leaves and very thin stalks. Great quantities are merely chewed and not swallowed, and are to be found all along the tracks covered with thick greasy saliva." Our records seem to refute this interesting observation. In the first place it would be extremely unusual for the female to have food habits differing from those of the male. In addition, the intestines of the large female that we shot contained some droppings of "leaves and very thin

stalks," while others contained stalks as coarse as those found in any of the hundreds of droppings examined.

All droppings appear to be "chewed and covered with thick greasy saliva," and as completely undigested as though they had never passed through the stomach. They often do not hold their form, and I wonder if it is not more likely that it was fragments of these to which Captain Brocklehurst referred in the second part of his statement.

On November 14, I had a most unusual opportunity to study the food habits of a panda. Four inches of snow covered the ground, and at 9 A.M. I encountered a barely perceptible giant panda track high on a mountain slope south of Chengwei. The animal had emerged from the very dense bamboo forest lower on the slope, and was on its way to the mixed growth of spruce and bamboo at a higher altitude. Snow had fallen during the night, and the track obviously had been made early that morning. For two miles it wound in and out through the bamboo thickets where the animal had fed, and the surprising detail was that at an average of every hundred yards there were from one to three large droppings (4 to 6 inches long and 2 inches thick, tapering at each end). At a conservative estimate there were 40 droppings when the track was still two hours old. At this point I disturbed the panda, but could not see it because of the dense bamboos. The animal had been resting at the base of a small spruce tree, and must have stopped feeding before 9 A.M. Below the resting place was a pile of at least 30 more droppings, making a total of 70 excreted between very early morning and 9 A.M. On his trail he had stopped occasionally to feed, but there was every reason to believe that the bulk of his meal had been obtained below the point at which I encountered the tracks. This instance led me to believe that the giant panda often feeds at night (as do several other large mammals of the region). I pursued this particular animal for three hours longer, and I found droppings almost as frequently for another four miles, although it had not stopped to feed meanwhile.

These droppings emerge almost totally undigested. It seems logical to assume that an animal of such large proportions must have to eat tremendous quantities to secure the nourishment that it requires. I found no definite evidence of pandas feeding during the greater part of the day in the case of the several individuals whose tracks I followed. Undoubtedly they *do* feed in very early morning and late evening, but it is my belief that the bulk of their food is taken at night. I estimate that they would have to spend from 10 to 12 hours a day feeding in order to secure sufficient for their needs. It is no wonder that the muscular development of their jaws is so massive, and that their teeth have become so adapted for breaking the bamboo, which will defy the edge of the sharpest axe.

Altitudinal range.—The limits of the giant panda's altitudinal range is

determined largely by the extent of the bamboo growth. Two exceptions to this statement were observed, however. In one case we found unmistakable panda droppings high on the Chen Lliang Shan range, 1000 feet above the rhododendron forest, and probably 1500 feet above the nearest bamboo. It was interesting to find that on occasion the panda must travel above its regular habitat to the bare grasslands of the blue sheep country. In another instance I saw where a giant panda had climbed a small pine tree just above the village of Tsapei on Chengou River. It was located 300 feet above the river bottom on an open slope, with the nearest bamboos across the valley. This particular record also indicates the stupidity of the panda. It had climbed the tree within 200 yards and in plain sight of a farmhouse. A hunter approached to within 60 feet before firing his old matchlock and before the panda descended the tree. This story was told to me by natives, and my visit to the place on the next day confirmed it. Fresh droppings at the foot of the tree and claw marks on the trunk bore witness to its truth.

Resting places.—The favorite resting places of pandas are at the bottom of trees, under dead stumps, and in crevices of ledges. Dens under overhanging rocks in the midst of a precipitous slope of bamboos were often seen. Bamboo stalks had been broken and arranged to form a nest, and old piles of droppings gave evidence of frequent use. The natives say that it is in such places that the mother brings forth her young. I saw an instance of a well-used panda bed on the top of a large flat stump in an opening of the bamboo forests.

There is no question that giant pandas climb coniferous trees of all types. Besides the one specific example mentioned above, we found several large spruce trees that appeared to have been climbed. The natives say that they do this to sun themselves. Ernst Schafer shot a baby panda out of a tree when in this same region with Brooke Dolan in 1931. When in a tree their color must make them very conspicuous, and it is in this situation that most of those shot by natives are discovered. One must not make the mistake, however, of assuming that every tree trunk which bears claw marks has been climbed. In several cases, when following a panda track along the crest of a high ridge, I could see where the animal had stopped at the base of a tree, stood on his hind legs with forepaws against the trunk, and then dropped to all fours and proceeded on its way. This habit is very much like that of our black bear.

Natural enemies.—I think it can safely be said that except for man, the mature giant panda has no natural enemies. The young, however, certainly would fall prey to the wild dogs and leopards of the region. At night we often heard the dogs hunting in packs, and I imagine that their depredations on game are easily as great as are those of the leopard.

Pandas should make formidable fighters but, strangely enough, the native dogs have no fear of them, although the dogs are afraid to molest the Himalayan black bear. The specimen that we shot hesitated long enough to growl

savagely, turn about, and bite one dog through the foot. Apparently they differ from the bear in that their jaws and teeth, rather than their forearms and paws, are their chief weapons of defense.

By climbing, the young panda could find refuge from wild dogs, but would always be at the mercy of a leopard. Their color is conspicuous when in the open, and without the background of snow they could easily be seen in the bamboos. Other animals with more natural enemies and living in exactly the same habitat are mostly dark in color and of a uniform shade. The takin is a rather bright orange and yellow color. It is doubtful, therefore, if the characteristic markings of the giant panda are protective.

Breeding habits and age.—Natives report that giant pandas mate in early spring, and that the females bring forth their young in January. Information of foreign hunters on this subject is of interest. Schafer informed me that the cub panda that he shot in April had milk teeth. Captain H. C. Brocklehurst shot a male in April and reported it to have been accompanied by a female. This hunter also stated that the panda he collected first made its whereabouts known by "a kind of roar" which natives informed him was made by the male panda during the mating season.

The Chinese hunters all seemed to agree that several years are required for a panda to attain mature growth. The reports varied from 4 to 10 years. The reliability of this information is very questionable and it is included merely because of the apparent concurrence of opinion on the part of the Chinese that the "Bei Shung" takes much longer to grow to full size than the bear.

Abundance.—One of the questions of greatest interest is the abundance of the giant panda. My opinion is based on personal observation and may not be entirely accurate. First, it should be pointed out that because of the nature of the habitat and the amount of sign left by one animal in a single day, it is virtually impossible to arrive at more than an approximate estimate of probable numbers before snow-fall. With snow on all the slopes and valley bottoms, however, one can reach a much safer conclusion.

During my month of hunting before snow fell I would have judged the panda to be rather scarce, but my experience in the next month led me to the belief that in this region the giant panda is not at all rare. In fact, for such a large mammal of nomadic habits, I would say it is plentiful. I base this statement on observations made between November 14 and December 8, when snow covered most of the mountains and valleys. I have what I consider to be almost positive evidence that within 6 miles of Chengwei (at the forks of Chengwei Creek and Chengou Creek) there were at least 6 different animals. When I speak of 6 miles I refer to the horizontal map distance. With the very close contours of this region it would include in reality a considerably greater land surface. It must be remembered, however, that we hunted (during this time) scarcely a tenth of the area where the panda might be found.

Two pandas were seen on November 16 in the Chengwei Valley. I departed two days later for the Mamogou Valley. The latter could not have been reached without crossing Chengo River Valley which was covered with snow, so there is little chance that the two animals referred to could have left the Chengwei Valley and gone to the well removed Mamogou slopes without our detection. I found unmistakable evidence of three more pandas in the Mamogou Valley. The size and location of the tracks offered proof of this statement. Another track was seen far up the valley of the "Da Bei Shui Gou," and still another just south of the Mamogou and Chengou streams. The day after leaving Mamogou Valley, we returned to Chengwei and found the tracks of two giant pandas far up on the east side of the valley. Assuming that these were the same animals as were seen on November 16, the total would still be six. As a matter of fact, I saw fairly fresh panda tracks on almost every slope that I hunted after snow had fallen.

I believe the panda is nomadic in habits, but I also think a single animal probably confines its range to one main valley. Each panda "makes the rounds," so to speak, about once a week. Seen in one place today, it probably would not return for a week.

Can the giant panda be caught alive?—This is a question that I have been asked so frequently by hunters and mammalogists alike that I take the opportunity of including my answer in this record. Properly equipped, I believe an ardent collector would have little trouble in capturing a panda alive, providing he could afford to spend a year in the country. An animal *might* be caught the second day, but, to insure success, a great deal of time should be allowed. Before attempting to transport such a live animal, it should be kept captive in its natural habitat for some time in an effort gradually to alter the diet from one composed exclusively of bamboo.

Hunting dogs of the right type would be the greatest help. The native dogs lack the persistence and ferocity necessary. Because of the sluggishness of the panda and the moisture ever present in its habitat, an excellent nose would not be an essential for a hunting dog.

I believe that the giant panda will walk into almost any trap set in an advantageous place and of sufficient strength. Natives frequently kill pandas by crudely set spear traps. Even a pitfall of the right construction should be effective. Chain traps such as developed by Vernon Bailey should be most effective of all. They are light in weight, and a large number could be taken into the country. I had two of these in 1934. They were crudely made by myself, and I did not have nearly enough time to set them properly. One was sprung by a giant panda the day before I left, but it had been set in one place over a month.

The greatest difficulty in trapping a panda is in finding a trail likely to be used. Since bamboo grows in such profusion all over the slopes the wanderings of a panda usually are entirely incalculable, and it is seldom that an

animal passes the same spot twice in many weeks. I found one ideal place, however, in which to set a trap. On any very high ridge running east and west the bamboo forest comes to an abrupt stop on the crest at the south side. The north side usually is rhododendron forest. The top of such a ridge is the limit of the panda range and in two cases I followed a track of a panda for a mile along such a summit. Again, a border of bamboos is often formed by an open field, and just inside the edge there is usually a natural trail for the Bei-Shung.

It seems strange that no live pandas have been caught by natives. Yet, if one stops to consider the inaccessibility of the panda's range, and the lack of well-worn trails, it is not surprising. In the second place it is only in very recent years that the natives have had any monetary incentive to attempt such a capture. It is my belief that an offer of high reward will yield a live giant panda in the course of the next few years. There is one supposed record of a giant panda cub observed in native captivity many years ago by an Englishman near Tatsienlu.

I believe further that the animal could be transported to another climate with little trouble. It is dull and primitive in temperament and would not, I think, be sensitive to rough treatment. The only problem, as mentioned before, would be the assurance of an adequate food supply.

Woodstock, Vermont.

THE MAMMALS OF THE QUETICO PROVINCIAL PARK OF ONTARIO

By Alvin R. Cahn

From the Lake of the Woods eastward to Lake Superior the international border between the United States and Canada is a water boundary. The Pigeon River, tumbling headlong into Lake Superior, marks the eastern end of this boundary. West of this turbulent stream, the lakeland area tilts toward the northwest, and all of its waters drain into the Lake of the Woods, which empties into the Winnipeg River, Lake Winnipeg, the Nelson River and so into Hudson Bay. Thus Minnesota is one of the very few regions in the United States with an arctic drainage.

Theodore Roosevelt set aside about one million acres on the south side of the water boundary and established the Superior National Forest of Minnesota. This was matched by Canada when, on November 7, 1913, the Quetico Provincial Park of Ontario, also some one million acres in extent, formally was established on the north side of the boundary. Thus, by international agreement, twin areas were set aside for public use and enjoyment—two areas of the greatest beauty to be found in the interior of North America. A strong

movement is now on foot to unite these twin areas into an international wilderness sanctuary, to preserve for all time the natural beauty and the wild life of this exceptional region.

The Quetico occupies an area approximately 50 by 50 miles. Its original northern boundary followed the chain of lakes and their connecting rivers between Windigoostigwan and Beaverhouse lakes, from one to twelve miles south of the Canadian National Railway. In 1931 this northern boundary was extended to the railway itself, but in 1934 the original northern limits were reëstablished. It is an area of rare beauty. Cut, scarred, and etched by the great glaciers that once covered the northern half of North America, it consists of endless huge rock ridges extending for the most part in a northeast-southwest direction. The valleys between the ridges contain probably over 2000 lakes of all sizes, very many of them connected by rivers into great chains. These waterways constitute the finest canoe country we have, and afford, besides their great natural beauty, some of the best fishing one could desire. The region lies in the heart of the great coniferous forest, where white and Norway pines are the dominant trees and form the climax, and areas of jack pine, poplar, and birch are developmental stages. There are great regions of swamp, where crooked streams wend their way through the soft ground, to the tune of humming mosquitoes. It is a region abounding in birds and mammals.

The writer made his first trip to the Quetico country during the summer of 1919, travelling mostly by compass and guesswork. This was followed during each succeeding summer through 1933 by trips varying in duration from 4 to 12 weeks, during which time he has thoroughly covered not only all of the Quetico Park itself, but most of the wilderness lying about it. From the southern boundary of the Superior National Park to the south, he has extended his investigations northward to Cat Lake and Lake St. Joseph and the Albany River. During his absence abroad in 1934, his place was taken by his assistant, Mr. DeTurk, who carried on observations throughout that summer. During the last 8 years, an intensive study has been made of the biota of the Quetico and its surrounding country. Already many of the native mammals have been exterminated, and others are rapidly approaching the point of extinction. In order that there may be a record of recent conditions in the region, this paper is offered. The material discussed has been gathered entirely by the writer and his assistants during 80 weeks spent in the region. The only trapping was for mice and shrews. The records for the larger game mammals are based on inspection of trappers' camps in many regions, on skulls found scattered through the area, and upon countless sight records of living animals. In all, some 300 specimens of mice, shrews and bats have been taken, and over 800 skulls have been examined.

Condylura cristata (Linnaeus). Star-nosed mole.—Because of the very rocky nature of most of the region under consideration, this mole is quite local in its distribution,

being confined to swampy areas where burrowing is possible. Here its run-ways are frequently seen as raised ridges, although the animal itself is but rarely in evidence. In 1932 I dug out a tunnel, and on reaching the nest was fortunate in capturing the female and two large though naked young. Specimens from Sturgeon Lake (Swampy Bay), Kahnipiminanikok (both McKenzie Arm and Kawa Bay), Pickerel, La Croix and Tanner lakes. The food of one specimen examined was composed entirely of insect remains, including bettles, ants, Hemiptera, and a few small crickets.

Sorex cinereus cinereus (Kerr). Masked shrew. The masked shrew is generally distributed over southern Ontario, but because of its seclusive habits it is encountered infrequently. It is an inhabitant of damp woods, especially along the edges of swampy areas, where its runways extend under logs and stumps and out into the woods. Apparently it avoids wet swamps as it does the more rocky areas. It is most common in birch and poplar groves; least common in stands of white or Norway pines. The food is composed almost entirely of insects, beetles, lepidopterous larvae, grubs of various Diptera, ants, and coleopterous larvae. On one occasion an earthworm was found, and on another the remains of a land snail. Specimens from the park headquarters at French Lake, Agnes Lake ranger station, Kahnipiminanikok (McKenzie Arm) and Swampy Bay of Sturgeon Lake.

Cryptotis parva. Little shrew.—This tiny, short-tailed shrew apparently is quite uncommon in the region. Six specimens were taken by DeTurk in 1934 at Agnes Lake, the swamp at the east end of McKenzie, the swamp between Kahnipiminanikok and Murdoch lakes, and Mack Lake.

Sorex palustris palustris (Richardson). Water shrew.—During 5 years of collecting in the Quetico country the presence of this shrew was not detected, but 2 specimens were collected by DeTurk in the summer of 1934. This shrew is highly aquatic, frequenting only very wet swamp areas. Its aquatic adaptations are indicated by the webbed union of the bases of the third and fourth toes, and by the large hind feet with their conspicuous rows of stiff hairs. Specimens from Agnes Lake and from the swamp at the east end of McKenzie Lake.

Microsorex hoyi intervectus Jackson. Pigmy shrew.—This shrew, the smallest North American mammal, is, I suspect, more common than data indicate. Its very small size, together with its retiring nature and inconspicuous habits, are sufficient cause for it to be easily overlooked in trapping operations. It is a species of the more open woods, avoiding swampy and wet areas almost entirely, as well as rocky places. It lives under fallen logs and among the roots of old stumps, where its tiny tunnels ramify into every cranny. It is likely to be discovered around any cabin or clearing, especially in the vicinity of disturbed ground. Its food consists largely of insects, with an occasional earthworm or small mollusk. It was not reported by Nash, and was recorded by Miller under the name of *Sorex hoyi*. Specimens from French and Northern Light lakes. At the latter location one was recovered from the stomach of a garter snake. Several were taken at Ely, Minnesota, by a Mr. Sigurd Olson.

Blarina brevicauda brevicauda (Say). Large short-tailed shrew.—This is the most abundant shrew of the region, being found almost everywhere. Specimens have been taken under logs, piles of leaves, and in rocky areas where no other small mammal is found. Since the writer feels that the subspecies *talpoides* is indistinguishable from *brevicauda* either externally or osteologically, the name *talpoides* has been rejected. For an animal so small, the short-tailed shrew exhibits surprising pugnacity and very quickly works itself into a violent temper, baring its teeth and squeaking furiously. Its food is composed mainly of insects, including all groups available. Specimens have been taken from almost every locality in and around the Quetico.

Myotis lucifugus lucifugus (LeConte). Little brown bat.—This bat is a common summer resident throughout the region, being the most abundant species. It is seen toward twilight flying over the lakes in search of its food, and after dark it often circles

for hours around the camp fire, probably with a similar purpose. The food consists entirely of insects, mostly Diptera, with chironomids, tipulids, small ephimerids and mosquitoes predominating. During the periodic flights of the May-flies, these insects are eaten in large numbers. Specimens taken on Basswood, Pickerel, Mack, Sturgeon, Kahnipiminanikok, Greenwood, McKenzie, Northern Light, Camel, and Knife lakes.

Myotis keenii septentrionalis (Say). Say bat.—This small bat is likely to be mistaken for *Myotis lucifugus* when on the wing, but it can be distinguished from the latter when in the hand by the fact that the ears, when brought forward, extend beyond the end of the nose. It seems to be of rather local distribution and is not common. Three specimens from Agnes, Kahnipiminanikok and Basswood lakes. This is the species formerly called *Myotis subulatus subulatus*.

Lasionycteris noctivagans (LeConte). Silver-haired bat.—Although Nash reported this to be a common species near the (Great?) Lakes, the writer has taken but 2 specimens in the Quetico; hence he feels that it is not common in the region. This large and very beautiful species was taken on Mack and on Northern Light lakes in the summer of 1932. It is associated with water, and is not to be found in the forest, as may be the representatives of the genus *Myotis*.

Eptesicus fuscus fuscus (Beauvois). Big brown bat.—This rather large, mouse-colored bat is distinctly uncommon in the Quetico country. It was reported by Nash as common and widely distributed, and by Miller as rare; Herrick reported it under the genus *Scotophilus*, but had no notes on its occurrence in Minnesota. Three specimens were taken at Lac de Mille Lacs in association with the specimen of *Nycteris cinerea*.

Nycteris borealis borealis (Müller). Red bat.—The little red bat is common throughout the region, but less so than is *Myotis lucifugus*. It is found both in the forest and in the clearings, and is frequently seen flying over lakes and rivers. Its distribution is fairly general, although it is more common in association with hardwoods than with evergreens. Several specimens have been taken in the great swamp of the Wawiag River, and up the Waikwabanona River, as well as at Mowe and Greenwood lakes.

Nycteris cinerea (Beauvois). Hoary bat.—This large and beautifully marked bat is very rare in the Quetico region. In August, 1931, I succeeded in capturing one specimen in the deserted logging camp buildings at the extreme northeastern tip of Lac de Mille Lacs by hitting it with a canoe paddle. After being examined carefully and its ectoparasites collected, it was laid on the table under an empty can, presumably dead, while I went in search of preserving material. On my return the can was found overturned, and the bat gone. No other specimen has been taken, yet having handled it for some 15 minutes, I am positive of its identity.

Euarctos americanus americanus (Pallas). Black bear.—There are still a number of bears in the Quetico and its vicinity, but their number is steadily decreasing as a result of relentless persecution by all parties involved, including the rangers of the park, who never miss an opportunity for destroying one. This is greatly to be regretted, for the bear is one of the most interesting of our mammals. Two excuses are given for its destruction. One is that it is dangerous to the tourists, which is no excuse at all, and the other that it damages the ranger cabins. If these cabins were properly built and maintained, this damage could be avoided entirely. The bears do enter windows and disturb things within, but this can be prevented entirely by placing a dark shade across the inside of the windows when the cabin is not in use. The animals do no damage to tourists; on the contrary, the tourists desire their presence, and a sight of a bear is the great thrill of a trip into the woods. The black phase predominates, and brown individuals seldom are seen. From 1925 to 1933 I saw 22 bears on Ottertrack, Knife, Camel, Basswood, Kahnipiminanikok, (especially McKenzie Arm), McKenzie, Mack, and Trout lakes, and along the Kababwagamac, Wawiag and Waikwabanona rivers.

Martes americana americana (Turton). Marten.—The marten is now practically if not completely extinct in the Quetico country. It has been exterminated from the Superior National Forest on the American side of the boundary. Trappers report seeing an occasional track in winter in the larger timber north of Saganaga and Saganagonse lakes, and I found one skull at a trapper's cabin up the Wawiag River in 1930. With the removal of the larger timber and their constant pursuit by trappers, the marten has retreated to the north. With proper protection in the region surrounding the Quetico, the species could be brought back.

Martes pennanti pennanti (Erxleben). Fisher.—The removal of the large timber has profoundly affected the distribution of the fisher, as it has that of the marten, and it is now to be regarded as extremely rare in the Quetico, although some still are to be found there. It has not yet quite reached the sad state of the marten, deplorable as is its condition. I have in my collection 17 skulls of fisher which I collected from about the camps of trappers up the Wawiag River. The small pit-fall type of trap built for the capture of these fine furbearers is a characteristic detail of the landscape in the more inaccessible parts of the Quetico and surrounding country. I have never seen a living specimen in the Park.

Mustela cicognanii cicognanii Bonaparte. Bonaparte weasel.—This is the abundant weasel of the region, and it is common throughout the Quetico country. It occurs both in the hardwood and in the evergreen areas, and is most frequently seen along the shores of lakes and rivers. It is by no means confined to such localities, however, and has been encountered in the heart of the forest at quite a distance from lakes or rivers of any considerable size. It is not as abundant in the Park as it was 10 years ago. Specimens seen on Basswood, Mack, Kahnipiminanikok, Agnes, Knife, Camel, Mowe, Northern Light, Sturgeon and Tanner lakes, and skulls have been found up the Wawiag River.

Mustela rixosa rixosa (Bangs). Least weasel.—This weasel is not abundant. It probably is often overlooked because of its small size. It has been seen more frequently in the vicinity of small, slow streams through hardwood growth than in the evergreen forests and about lakes. Apparently it prefers swampy areas to dense woods or rocks. It has been seen on 5 occasions along the Wawiag and Kababwagamak rivers and in the swamp area around the north end of Ferguson Lake. Specimens from Ferguson and Mack lakes.

Mustela longicauda spadix (Bangs). Minnesota weasel.—This large weasel was not seen by the writer, but between 1929 and 1932, 3 skulls were gathered from trappers camps along the upper Wawiag River. This fact indicates that the animal is quite uncommon, and no notes are at hand regarding its habits or haunts.

Mustela vison lacustris (Preble). Mink.—The mink is still fairly common throughout the region, but has steadily decreased in abundance during the past 10 years. It may be seen about the rocky shores of both lakes and rivers, especially about the larger bodies of water. In August, 1933, a female and 2 young were watched for 15 minutes while they fed upon a dead sucker on the shore. They are often seen in pairs during the latter part of the summer, while solitary individuals or family groups are more often met in the early part of the season. They feed upon any mammal, duck, or fish available, and the remains of several spruce hens have been found with mink signs about. The writer has about 50 skulls taken from trappers' camps up the Wawiag River, which indicates the degree to which these animals are trapped about the edge of the park; their skulls are among the commonest in such places. Specimens have been seen in the following localities: Basswood, Mack, Lac la Croix, Crooked, Pickerel, Mowe, Northern Light, and Greenwood lakes, and along the Maligne, Wawiag, and Kababwagamak rivers.

Gulo luscus (Linnaeus). Wolverine.—The original range of the wolverine undoubtedly covered the territory in question, but it was extirpated long ago. The older

trappers operating around the edge of the Quetico place the time of its disappearance from the region at about 1900.

Lutra canadensis canadensis (Schreber). Canada otter.—This is another fine animal whose numbers have been greatly reduced in recent years, until now it is but rarely seen. Its scats, composed largely of crayfish remains, are often encountered, however, indicating that there are more individuals present than the sight records suggest. The animals frequent rocky areas and have their dens under piles of rocks, inaccessible and hence safe—except from the trapper. Crayfish form an important item in their diet, but occasional fish and bird bones indicate other food. On McKenzie Lake I once watched, spellbound, while an otter stalked a coot (*Fulica americana*) that was swimming about over deep water. The otter swam across the lake, approaching the coot. Every now and again it rose to an almost perpendicular position and looked around. When about 100 yards from the bird the otter saw it. For a few seconds it watched the bird intently, apparently fixing the location in its mind. Then the otter dived. Fortunately or unfortunately the coot saw the otter during this brief period of observation, and as the seconds passed while the otter was under water, the coot seemed to become increasingly uneasy, swimming about in a zig-zag course, its head bobbing from side to side. Finally the strain appeared to be too great for it, and it flapped away. Five seconds later the otter came to the surface within 2 feet of where the bird had been. It looked about for a moment before swimming slowly to the shore and disappearing. I have 6 otter skulls from the Wawiag country, and have seen the animals on Kahnipiminanikok (McKenzie Arm), McKenzie, Basswood, Camel, Mack, and Ferguson lakes.

Mephitis mephitis (Schreber). Canada skunk.—The skunk is common only locally, where the physical conditions of the country are congenial. It is found where soil is deep and digging possible, but is absent from regions that are conspicuously rocky. About clearings and under cabins its holes are in evidence, although the animal is rarely seen. It has repeatedly taken its own picture with cameras set over night. I have 3 skulls from the Wawiag River country, and one from Greenwood Lake. I have found its holes about the headquarters cabins at French Lake, and about the ranger cabin on Agnes Lake. One was found recently dead—apparently the work of hawk or owl—at Kahnipiminanikok Lake, the stomach containing insect remains and some soft-bodied larvae.

Taxidea taxus taxus (Schreber). Badger.—The badger probably is now extinct in the Quetico region, and for years it has been exceedingly rare. In the summer of 1922, three of us watched a badger lying in the mouth of his hole for a half hour, sunning itself. The location was the north shore of the central portion of Knife Lake, and the hole occupied led under a great pile of rocks. This is the only record I have for the species; no skulls have been found.

Vulpes fulva (Desmarest). Red fox.—This animal still is fairly common throughout the region, but because of trapping it is steadily decreasing in numbers. I have 22 skulls taken from the trappers' piles up the Wawiag alone, and could have brought in three times as many had I so desired. It is very shy and retiring and is almost never seen, although in the summer it is sometimes heard barking, especially in the latter part of the season. In the summer of 1927 I had the good fortune to see, very early one misty morning, a vixen with 4 pups running a rabbit trail. The mother was in the lead, loping slowly along, and after her came the pups, yapping in great style and falling all over themselves in their eagerness to keep pace. A questionnaire to rangers and trappers brought out the fact that the red, cross, black, and silver-gray foxes (all phases of *Vulpes fulva*) are found in the region, but the red greatly predominates. Specimens (skulls) from Kahnipiminanikok, Northern Light, Mowe, Greenwood, and Saganaga lakes, and from the Wawiag River.

Canis latrans Say. Brush wolf, or coyote.—This large species of coyote is plentiful

in the region and the number has not been lessened appreciably by the trapping done especially for them and for the timber wolves. They are solitary in summer, and gather into packs late in the fall. They do some damage to game, but to no alarming degree. Their favorite food is rabbit and grouse. Skulls are found in every pile of bones about trapper cabins, indicating a general distribution. Specimens from the Wawiag River and from 26 different lakes, 15 of them within the limits of the Park.

Canis lycaon lycaon Schreber. Eastern timber wolf.—In spite of statements to the contrary, timber wolves are still common both in the Quetico and in the Superior National Forest to the south, and they cross back and forth freely between the two areas. There have been numerous and spasmodic drives to rid these areas of these "terrible" animals because of their "serious" depredations on deer and moose. These outbursts (and in the Superior National Forest at least, they are purely political gestures) have resulted in the killing of about everything *except* wolves, which usually elude most cleverly the clumsy efforts to trap them. In the late fall their call is to be heard frequently all over the Quetico, but in all my travels I have seen but 2 live wolves—one at Kahnipiminanikok, the other at Northern Light Lake. I have over 40 skulls which I have retrieved, but many more were available. Their persecution is to be regretted, for they form a perfectly natural and normal check on other species.

Lynx canadensis canadensis Kerr. Canada lynx.—Formerly a common resident of the area, this animal is now practically extirpated, although an occasional individual may still stray into the region from the north. I have 2 skulls, collected during 12 years, both from the country drained by the Wawiag River. The extermination of the species is due largely to the work of man, especially trappers, both by the use of traps and by poison.

Lynx rufus rufus (Schreber). Bay lynx, or bob-cat.—This cat formerly was not uncommon in the Quetico country, but it is now exterminated, and it is doubtful if any have been noted during the last 15 years. I have one skull, given me by an old trapper, that is supposed to have come from Northern Light Lake about 1916.

Marmota monax canadensis (Erxleben). Canada woodchuck.—The woodchuck is common throughout the region in suitable localities. It is found especially about clearings where digging is possible, but also it occurs in natural holes under rocks. The animals prefer hardwood forest to evergreen stands, probably because of the different nature of the ground involved. Those examined have been found to be strictly vegetarian in their food habits. They frequently are seen about Knife, Basswood, Saganaga, Kahnipiminanikok, French, Northern Light, La Croix, Crooked and Sturgeon lakes, and along the Maligne, Wawiag, and Kababwagamak rivers. Skulls from the Wawiag country and from scattered regions covering the park.

Eutamias minimus jacksoni Howell. Lake Superior chipmunk.—This little chipmunk is found all over the Park and through the adjacent country. It is abundant everywhere, especially around cabins and regularly used camp sites. It is very tame and quite fearless, so that it becomes a fascinating nuisance about camp. The sense of curiosity is not to be denied, and the little creatures are not happy until every pack sack has been investigated repeatedly, and every package sampled. They respond quickly to human advances and eat from one's hand within a few hours. Most of the food is taken in the cheek pouches and stored in underground holes for future use, the animals being indefatigable in their transportation activities. The species seems to be about equally abundant in hardwood and evergreen forests. The food consists of both berries and nuts, hazel nuts being especially prized when obtainable. Specimens seen at practically every camp site in and about the Quetico.

Tamias striatus griseus Mearns. Gray eastern chipmunk.—This much larger chipmunk is found only in the southern part of the Quetico, especially along the international

boundary, where it is more common than is *Eutamias*. Elsewhere it is decidedly rare. It is particularly abundant about Prairie Portage, the eastern inlet of Basswood Lake. Its habits and general behavior are similar to those of the small chipmunk, but it is of a decidedly more pugnacious temperament in regard to other individuals of the species. Specimens from Knife, Basswood, and southern Agnes lakes only.

Sciurus hudsonicus hudsonicus (Erxleben). Red squirrel.—This is the only squirrel found in the region, and it is both abundant and general in its distribution. It is commonest in the evergreen forests, especially those of jack pine, and in these stands they feed upon the cones. In hardwood regions they gather about hazelnut areas when these nuts ripen, and are kept busy driving away the chipmunks.

Glaucomys sabrinus sabrinus (Shaw). Hudson Bay flying squirrel.—These shy, retiring, crepuscular and nocturnal creatures probably are more common than the data indicate, for their unobtrusive habits and subdued coloration render them poor subjects for observation. Occasionally one is seen sailing like a ghost through the forest, but such a sight is a rare one. Those I have obtained were caught in traps set for squirrels and chipmunks, baited with uncooked oatmeal. Records from Kahnipiminanikok, Mack, and McKenzie lakes.

Castor canadensis canadensis Kuhl. Canada beaver.—The story of the beaver in the Quetico and in the adjacent Superior National Forest of Minnesota is a tragedy of the most sordid kind. It is a tale of greed and mismanagement, resulting in the reduction of the beaver from an abundant species to one of comparative rarity. It has been trapped by the thousands by outlaw trappers, mostly from the American side of the boundary. Twenty years ago a traveler by canoe could see beaver in the region any and every day; now a wanderer in the most inaccessible places is fortunate to see or hear half a dozen during a summer. Hundreds of "dead" houses are to be seen, in comparison with a few dozen "live" ones, as indicated by the presence of fresh cuttings about the lodges. In 1930 and 1931 the situation was at its worst; in 1932 and 1933 there were hopeful signs that the persecution had slackened because of the scarcity of the animals and the low value of their fine fur. On the boundary I once found a pile of beaver bones more than 3 feet high, from which I selected 35 perfect skulls of all sizes. During late August of 1933 I found 11 freshly skinned carcasses in the heart of the Quetico. As a result of the destruction of the beaver, many of their dams, which in some sections made canoe travel possible through raising of the water, have fallen into disrepair, and now such streams are impossible of navigation. The common explanation offered by the natives is the naïve one that the beaver have migrated.

Peromyscus maniculatus gracilis (LeConte). White-footed mouse.—This is the common deer-mouse of the region and it is abundant. It frequents the low, wooded areas, and is conspicuously absent from the grassy swamp habitat. It is more common in hardwood areas than in evergreen regions. The nests are placed under fallen logs and are lined with shredded leaves, and the runways extend under decaying logs and debris in general. The food consists of a large variety of seeds and ground beetles. The young usually number 4. In the Quetico this form seems to intergrade with the next subspecies, but resembles *gracilis* more nearly than it does *maniculatus*. Its range extends southward through the Superior National Forest. Specimens from Camel, Northern Light, Kahnipiminanikok, Sturgeon (Swampy Bay), northern part of Agnes, Mack, Pickerel, Basswood, and Knife lakes, and the Shelly-Keats Portage.

Peromyscus maniculatus maniculatus (Wagner). Labrador white-footed mouse.—This is a northern form of the deer mouse that, from the evidence at hand, is the common form in the region north of the Quetico, although it does not come south to the Quetico itself. It is almost indistinguishable from the preceding subspecies, but has a longer tail and a smaller hind foot. Specimens from north of the Canadian Pacific Railroad: Cat, Woman, St. Joseph, and Shabimini lakes.

Synaptomys cooperi cooperi Baird. Cooper lemming mouse.—This species is very rare, according to the data at hand. It has been taken but once, on Greenwood Lake, in August, 1933. Its presence in Ontario is not mentioned by either Nash or Gapper, but it is recorded by Miller under the name of *Synaptomys fatuus*.

Clethrionomys gapperi gapperi (Vigors). Red-backed mouse.—This is by far the most abundant small rodent in the region and apparently is common everywhere excepting only swampy areas. It is active by day as well as by night and may be seen in broad daylight running from one hole to another. The ground is full of their holes, and they do not have runways except in grassy areas, where these appear as a network ramifying in every direction. The burrows descend about 6 inches almost vertically, then progress, usually unbranched but in a highly irregular manner, for a distance of from 4 to 8 feet, at the end of which is the nest chamber. The food consists entirely of vegetable matter and is composed of the succulent parts of low plants, rather than of seeds or berries. Records cover the entire Quetico and all of the contiguous territory.

Microtus pennsylvanicus drummondii (Audubon and Bachman). Drummond meadow-mouse.—This is a very common mouse over the wooded areas of the Quetico and vicinity, being absent only from wet, swampy areas. More commonly it is found in hardwood stands than in evergreens. It is largely nocturnal or slightly crepuscular, seldom being seen during the day. It burrows under fallen logs or in soil, but the tunnels are short when compared with those of *Clethrionomys*. The food consists entirely of vegetable matter, chiefly grasses and succulent herbage. Both the meadow-mouse and the red-backed mouse are frequently preyed upon by owls, and many skulls have been recovered from pellets. Specimens from all over the Park; especially abundant about Kahnipiminanikok, Mack, Northern Light, and Greenwood lakes.

Ondatra zibethica zibethica (Linnaeus). Muskrat.—The muskrat still is common in the Quetico, but far less so than formerly, because of over-trapping. It is a swamp form, absent from lakes or areas that are largely rocky, although swampy bays of rocky lakes are likely to have a muskrat population. They are especially numerous up the Wawiag River and in the Deus Revierre country, being more common along small streams and in swamps than in small lakes, even when the latter seem admirably suited to their mode of life. The muskrat trapping, like that of the beaver, has been merciless, and innumerable carcasses were found all over the region. Instead of building houses they burrow in the soft banks and have their nests at the end of burrows. Specimens have been seen all over the Park and neighboring regions.

Mus musculus musculus Linnaeus. House mouse.—The house mouse is distributed over the whole area and is a common species. It is taken most often about clearings, and especially in the neighborhood of cabins. During the summer the species ranges into the forest, but does not penetrate far from the more open areas and is more common in hardwood regions than elsewhere. With the approach of cold weather many individuals seek shelter in the cabins, which are often overrun with them. While in the woods they are seen but seldom and are trapped infrequently, but about cabins they are much in evidence and often do considerable damage. I have found nests and young in ranger and trapper cabins repeatedly, but never elsewhere. Specimens taken from all over the Quetico and on all sides of it.

Rattus norvegicus (Erxleben). Norway rat.—This is the only rat found in the region and is abundant only about man-made clearings. Around recently deserted cabins and more especially around lumber camps, rats are common; elsewhere they are not encountered. Hence they occur more commonly along the railroad and along the international boundary. Specimens have been seen or taken on Basswood, Knife, Otter-track, Northern Light, French, Eva, Jean, Quetico, Batchawong, Crooked, La Croix lakes, and Lac de Mille, and about the cabins of trappers up the Wawiag River.

Zapus hudsonius hudsonius (Zimmerman). Hudson Bay jumping mouse.—This most interesting and attractive little mouse is probably more common than the data indicate, as it is difficult to trap. For several years its presence was unsuspected, even in ideal areas, until finally one was caught. The animals frequent wet, grassy swamp areas, usually rich in sedges and having a soft, mucky ground surface. Here their little runways are seen weaving in and out among the taller grasses and rushes, disappearing under the thick vegetation, so that one must go down on hands and knees in order to follow them. I have never found the nest, although dozens of runways have been followed with care. The food is composed entirely of vegetable matter, and includes most of the succulent grasses and herbs as well as occasional seeds. Specimens from Greenwood, Swampy Bay of Sturgeon, McKenzie Arm (north tip) of Kahnipiminanikok, Mack, and French lakes, and from the Wawiag River country.

Erethizon dorsatum dorsatum (Linnaeus). Porcupine.—This is a common resident of the Quetico country, although less common than formerly. The animals frequent evergreens more than hardwoods, and the dry forest in preference to wet areas, although they are often encountered when they come to the lake or river shore to feed or drink. They are very fond of aquatic vegetation and favor the water lilies when these can be reached from the shore. They do some damage to pine and spruce and I have seen a number of trees killed by their girdling; but the total amount of damage is insignificant. About camp they are a nuisance, but they are interesting and amusing and should not be killed for lack of something better to do. Specimens from every region of the Park and neighboring country.

Lepus americanus phaeonotus Allen. Minnesota varying hare.—This is the only rabbit in the area and is periodically abundant. The animals frequent the less dense forest and cleared areas about hardwood tracts, and much less commonly the evergreen stands; they are practically absent in climax stands of pine. They afford food for the wolf, coyote, and fox, and for the larger owls, and constitute an important link in the lives of many vertebrate forms. Young are to be seen by the middle or the end of June, and these are well grown by early September. Specimens seen from nearly every quarter of the Park, the species being more abundant in the country to the north and northeast.

Cervus canadensis canadensis (Erxleben). Elk.—The elk was once an inhabitant of the Quetico country, but has long been extinct in the region. I have in my collection a single shed antler of an elk, almost consumed by porcupines. It was given to me by a native of the Port Arthur country in 1924, and came from the north shore of Northern Light Lake in the early nineties. A similar fragment was found in Pickerel Lake in 1926. Elk were introduced into the Superior National Forest of Minnesota in 1914 or 1915, and on at least one occasion some members of this herd were seen in the Quetico Park.

Odocoileus virginianus borealis (Miller). Virginia deer.—The deer is still an abundant inhabitant of the area, in spite of persistent shooting on all sides of the Park. Although a frequenter of both hardwood and evergreen country, it is most common in the former. Its favorite habitat seems to be in burned-over country and in second growth stands in timber, and it is much less common in climax forest than elsewhere. During the winter some are killed by wolves, but such depredations are not at all serious and have not affected the population to any appreciable extent. In summer they may be seen almost daily when they come to the lake shore to drink, or when feeding in the swampy bays. Usually they have but one fawn, but sometimes there are twins, and once I saw a doe with triplets. Records from all over the Park and adjacent country.

Alces americana americana (Clinton). Moose.—Until about 1932 the moose was a very common animal all through the Quetico, but it has been greatly depleted during

recent years, as the result of an epidemic disease apparently associated with tick infection. This disease has been reported upon by Wallace, Cahn, and Thomas. An encounter with this great animal always is thrilling, and it is one of the most important attractions within the park. They occur in swampy areas, where they come to feed on the buds, stems, and roots of the water lily. Where moose are active one finds great beds of these plants with every bud severed. In a puddle near Camel Lake I found the moose pulling up and eating the succulent root system of these plants, and hundreds of huge half-eaten roots were floating on the surface. Normally the cow has a single calf, but twins are not uncommon. I have heard of triplets, but have never seen them. Occasionally the youngsters are almost fox red in color. The bulls reach great size. I have a pair of horns which I found up the river leading from Cache Lake to Kahnipiminanikok, that have 32 points and a spread of 59.5 inches—a magnificent set. The animal apparently had broken through thin ice and was unable to regain the shore. This is not an uncommon type of accident both to deer and moose. The number of moose in the Quetico is much less than formerly, while in the Superior National Forest the species is now almost rare. The best moose regions I know are the following: The northern tip of McKenzie Arm of Kahnipiminanikok, Swampy Bay of Sturgeon, Ferguson Lake, and the rivers and small swampy lakes in the neighborhood of Camel Lake.

Rangifer caribou caribou (Gmelin) Woodland caribou.—The caribou is extinct in the Quetico, although this region once was the approximate southern limit of its winter migration. There are no records in recent years. Nash reported it as very shy but not rare in the Whiteface and St. Louis River country of northern Minnesota as late as 1894. In my collection I have a badly weather-worn, moss-covered, porcupine-chewed horn found near Knife Lake in 1929, and this constitutes the last record I have of this splendid animal in the Quetico country. There is an abundance of its favorite food, the caribou moss, *Cladonia rangiferina*, throughout the region.

LITERATURE CITED

Coventry, A. F. 1932. Further notes on the Amphibia and Mammalia of the Temagami District, Ontario. Canadian Field Nat., vol. 46, pp. 145–147.

Cross, E. C., and J. R. Dymond. 1929. The Mammals of Ontario. Roy. Ontario Mus. Handb. no. 1.

Dymond, J. R. 1928. The mammals of the Lake Nipigon region. Trans. Roy. Canadian Inst., vol. 16, pp. 233–291.

Gapper, Anthony. 1830. Observations on the quadrupeds found in the district of Upper Canada extending between York and Lake Simcoe, with a view of illustrating their geographical distribution, as well as of describing some species hitherto unnoticed. Zool. Jour., vol. 5, pp. 201–207.

Herrick, C. L. 1892. Mammals of Minnesota. Geol. Nat. Hist. Surv. Minnesota, Bull. no. 5.

Hope, C. E. 1933. Two new mammals for the Toronto region list. Canadian Field Nat., vol. 47, p. 176.

Miller, G. S., Jr. 1897. Notes on the mammals of Ontario. Proc. Boston Soc. Nat. Hist., vol. 28, pp. 1–44.

Nash, C. W. 1905. Check list of the vertebrates of Ontario: Mammals. Dept. Educ., Ontario.

Saunders, W. E. 1932. Notes on the mammals of Ontario. Trans. Roy. Canadian Inst., vol. 18, pp. 271–309.

Snyder, L. L. 1928. The mammals of the Lake Abitibi region. Univ. Toronto Stud., Biol. Ser., vol. 32.

SWANSON, G., and P. O. FRYKLUND. 1935. The least weasel in Minnesota and its fluctuation in numbers. Amer. Midl. Nat., vol. 16, pp. 120–126.

WALLACE, G. I., A. R. CAHN, and L. J. THOMAS. 1933. Klebsiella paralytica: A new pathogenic bacterium from moose disease. Jour. Infect. Dis., vol. 53, pp. 386–414.

Tennessee Valley Authority, Knoxville, Tennessee.

WILLIAM H. PARKINSON: CALIFORNIA NATURALIST

BY JEAN M. LINSDALE

Any person who spends much time in the mountains of the West is sure to encounter sequestered naturalists—people who may not be well known outside their own neighborhood but whose interest in and knowledge of nature would rank high in any company. In the preparation of a manuscript on the natural history of the fur-bearing mammals of California, a major task was the search for naturalists of this type in order to learn from them as much as possible of human experiences with those elusive animals. Among all the men questioned for this purpose, one stood out with prominence so great as to merit this special sketch of some of the main events in his life as it was concerned with animals. The book mentioned above, by Grinnell, Dixon, and Linsdale (Univ. Calif. Press, 1937), contains many items contributed by this man.

I became acquainted with William H. Parkinson in 1926 when I was collecting vertebrates in the Sierra Nevada near Shaver Ranger Station, Fresno County, California. My camp was close to Parkinson's house and this made possible many long conversations. I became greatly impressed by the extent and the dependability of his knowledge of wildlife, as well as by his sincere interest in nature and exceptional ability to remember and to relate his experiences. Later, in response to urgent appeals, he wrote out long accounts of his experiences with the various kinds of fur-bearing mammals. Parts of these were used in the book on fur mammals. Genuine modesty was reflected in statements among some of the first of these accounts to arrive. For example, he wrote: "I have gained quite a store of knowledge of the wild animals of the West, partly through good fortune, and partly through hard work. Altogether I feel that I have been greatly favored, and if these accounts will help you in your work in the least degree, they shall be at your disposal." Another time: "I can express myself more clearly, perhaps, around a campfire before a limited and sympathetic audience than I shall be able to do with cold ink and paper. However, I will tell it all in my own way and you may pick out whatever you find useful."

Another reflection of Parkinson's attitude is contained in the following comment written by him to acknowledge the receipt of a copy of the book "Animal Life in the Yosemite." "I have spent fourteen different vacations

in Yosemite Park during the past thirty years, and have tramped over most of the country covered by the book. I feel that in this book I have met an old friend. And in its scientific descriptions I shall always feel that I have a record and authority—a feeling that I have never had completely toward any other book on wildlife."

Parkinson was interested in animals throughout his life. He watched them at all seasons of the year and in many varied localities. He knew much about the smaller, inconspicuous birds and mammals and had first-hand knowledge of the lives of most of them. In addition, he had talked with everyone in the region who showed any interest in animals, and he profited by their observations; but he received these critically. Moreover, he seemed to have made very few mistakes in drawing his own inferences. He worked for the Forest Service most of the time, with furloughs in winter to trap. Trapping sometimes brought him as much as $250 a month. In most of the areas where this was done no other person ever had trapped commercially. This applied to localities in the south coast ranges in Monterey County, and the southern part of the state in Orange County, as well as to the central Sierra Nevada in Fresno, Mariposa, and Tuolumne counties. He trapped above 7000 feet altitude in the Sierra Nevada for three winters.

Although the present discussion is concerned mainly with Parkinson's experiences as a trapper, he was an expert also with a rifle and he hunted a great deal with a gun. Except on rare occasions, however, he never hunted with dogs. His interest in outdoor things extended far beyond the capture of game and he spent more time stalking and studying small animals than in the pursuit of large ones. In fact, many of his most valuable observations were made outside the hunting and trapping season; he was alert whenever an opportunity came to add to his experiences.

More than 40 years ago, when Parkinson was a small boy, he started trapping gray foxes. At that time he lived in Cholame Valley near the small town of Parkfield, Monterey County. "Cholame" is an Indian name meaning fox. There were, and still are, many gray foxes in this locality, as well as a considerable number of golden eagles. Parkinson's own story of some of his experiences with these animals is as follows: "On several occasions I found where these big birds had killed and eaten my trapped foxes; at least all the evidence showed that the eagles had killed the animals. I knew they ate them, for I found them doing it. About one mile north of our house was a ridge called the Middle Ridge, as it was the dividing ridge between the Big Cholame and Little Cholame. We lived in Big Cholame. Along the crest of this ridge, opposite our house, grew a number of large digger pines, and in one of these a pair of golden eagles nested year after year. At every opportunity during the nesting season I would slip away and spend hours watching this nest. I often saw the old birds bringing in food, usually ground squirrels, to the nest; but now and then rabbits were brought. The heads

of these animals with the skin rolled back over them were often cast to the ground beneath the nest tree. Among them I once found the remains of a gray fox. I wondered if the eagles had caught it or if they had found it dead and brought it in. I talked to some neighbor boys who were professional hunters, telling them of what I had found, and they told me that eagles ate foxes often, foxes which they caught and killed for themselves. I do not remember what their evidence was, but it was enough for me, as I had great faith in those young men, and from that time on I knew that eagles caught and killed foxes. But for a man who has spent the greater part of his life in the wilds I was a long time in getting my own evidence.

"In the fall of 1896, we moved to Tuolumne County, and there, as in Cholame, I trapped foxes in the winter months. Most of my trapping was carried on in the brush country around the mining camps. Gray foxes were plentiful; also quite a number of eagles ranged there. As in Cholame, these eagles ate several trapped foxes; but I never was lucky enough to see them kill the animals.

"In 1900, we moved again, this time to Mariposa County. We lived in this county several years, near the old Darrah P. O., and, as usual, I spent a lot of time hunting and trapping. There were plenty of gray foxes and some eagles, and, as in every other locality where I had trapped, these birds ate a few trapped foxes. Other trappers in that locality had the same experience; not one of them ever had seen the birds kill a fox. It began to look as though I would never get the evidence I so much desired.

"Now, the California gray fox has one very peculiar habit. On cold, clear days in winter, just before a storm, a fox will often climb up on a rock where the surrounding brush grows higher than the top and there curl up and treat himself to a sun bath. He is hidden from all sides, but is generally visible from some higher ridge or from above. I have actually seen them doing this many times.

"In late November, 1904, I was traveling a little-used trail along the apron of Kirby Mountain, between the C. L. Boothe ranch and the old Westfall place, in Mariposa County. It was about 10 a.m. and a clear, cold day. I was not thinking of eagles or of foxes. Suddenly I heard the familiar roar of an eagle diving. I glanced up and there it was, almost directly over me and seven or eight hundred feet up. I froze in my tracks, but was nearly hidden in the brush-grown trail anyway. The eagle was coming down at a slight angle, bearing to my left where there was a densely brush-covered, rocky slope. On it came with the speed of a falling stone and wings almost closed. When it had arrived within two hundred feet of the ground and about the same distance to my left, a gray fox began to scream in a high-pitched voice, the terror expressed being absolute. Just before reaching the brush, the eagle spread its wings and slacked its speed as it disappeared from my view. The cries of the fox were then mixed with high pitched growls

which soon diminished to squeaks and in a very short time ceased altogether. I could hear the beating of wings in the brush, but soon that too ceased. I crept through the brush as silently as possible and found that the eagle was tearing away at the fox on the ground beneath the brush. It became aware of my presence almost at once, and had quite a hard time getting launched into the air owing to the density of the brush.

"The fox was dead; beside it was a rock about five feet high and several feet in diameter. Tufts of fur, and some blood spots, showed that the battle started on top of this rock. The bird had lost a feather or two, but it showed no evidence of having been injured when it flew away. This eagle had caught and killed a free fox. The eyes had been torn out, but death was caused by talon punctures of the heart and lungs.

"Can anyone tell me why this fox, a full-grown female, would scream with terror at the approach of an eagle, and yet remain on top of this rock when certain safety lay in one short leap to the protection of the adjacent brush?

Another story, selected from the accounts prepared by Parkinson, gives further insight into his attitude toward animals and the characteristic manner in which he assembled his rich stock of experiences with them. The following paragraphs are quoted from his manuscript on the Sierra pine marten. "In June, 1898, I left the old mining camp of Confidence, Tuolumne County, California, with a party of fishermen headed for Kennedy Lake, on the headwaters of the Stanislaus River, just west of Sonora Peak. We traveled over the, then abandoned, old Sonora and Mono Toll Road as far as Baker's Station, where we left our wagons and packed in to the lake, a distance of about ten miles."

"This trip was like entering a different world. I had never been in high mountain country and every mile of our trip going in disclosed some animal or bird that was a perfect stranger and a source of wonder, fascination, and delight. If I were a writer, I could easily write a book on the wonders of this three-weeks trip.

"I suppose the other members of the party grew weary of answering my questions, for they were all experienced mountain travelers. When we reached the lake, instead of paying much attention to the fishing, I spent most of the daylight hours wandering over the surrounding mountainsides, ridges and side valleys. Here, I saw my first ground hog or marmot, "stake pins" (Belding ground squirrel), grouse, Clark crow, porcupine (only one), and golden-mantled ground squirrel. Also the antics of the Douglas squirrels drew a lot of my attention, and I never tired of watching them in the timber.

"It was while engaged in this last-mentioned pastime that I saw my first pine marten. I was lying at the base of a big fir, keeping perfectly still, when suddenly there was a warning note, sounded by chipmunks and squirrels, which I supposed was caused by a hawk. Then straight out in the trees before me and at nearly a right angle came a very large, brown 'squirrel,'

going rapidly from one tree to another by running along the branches, jumping gaps of several feet, going up in some trees and down in others, seeking out the least difficult line of travel but never reaching the ground. It soon disappeared in the forest. 'Well!' said I, 'that is another squirrel I never heard of and I'll have to ask the boys about it.' But they were not much interested in my 'land discoveries' and passed it off with the remark, 'you will see lots of funny animals in these woods.'

"The time of year was about June 20, the elevation about eight thousand feet. There was plenty of snow in patches on the north slopes, but not enough to make tracking possible, as you would soon lose the trail on bare rocks or fir needles. And even if I had seen marten tracks, I would not have recognized them as such. I doubt if I had ever heard of a pine marten at that time, except in books, and certainly I had never heard of this animal as being in the Sierra Nevada. Therefore, the one I saw traveling through the trees, and the family of young I found a few days later, were squirrels to me at that time and for several years thereafter. But I was seeing strange animals every day, and this new animal interested me probably as much as a squirrel as it would had I known it was a pine marten.

"The den was about one-fourth mile from where I had seen the adult in the trees and in the direction it had traveled. It was in a big fir which had been struck by lightning years before, leaving a strip of dead wood down one side. About sixty feet up and just beneath a dead limb there was a hole, probably an abandoned pileated woodpecker's nest. I located the den late one evening. The young marten, four in number, were out playing near this hole.

"What first drew my attention was the noise they made, a sort of squealing sound that also fit in with my notion of squirrels. They played just like young gray squirrels, chasing each other up and down the body of the tree and out on limbs. Once, all four gathered on one limb at the same time, above and to one side of the nest, but they were not quiet for long. They would slap at each other just like cats, but always in fun. The orange spot under the chin and on the throat showed plainly, but it was a very pale, light color, and the entire body was much paler in color than the adult I had seen. Aside from the slapping at each other with their paws, they acted no different from young squirrels at play.

"I kept expecting to see the mother, but she did not appear. Finally it became late and I decided to go to camp, so I made my presence known by yelling as loudly as I could. At the first sound, they made for the den hole and popped in like flashes. How many times since then have I lamented the fact that I did not know they were pine marten. I have found several marten den-trees in winter, but I never had another opportunity to watch them in summer."

In his own comments on the marten story, Parkinson wrote as follows:

"In my accounts of the marten, I have had to disagree, somewhat, with accounts I have read and heard. However, the other fellow probably saw certain things that I never happened to see—and, knowing that there is no hard and fast rule in these matters, climate and seasonal changes being a big factor in the life of Nature's children, we may feel sure that some of these differences may be accounted for in this way."

Parkinson made a great many short trips through the mountains, and on these he was always on the lookout for new facts concerning animals. During the first week of October, 1905, he, with Mr. R. W. De Moss of Mariposa, took a rambling trip through the old Gibbons cattle range in Yosemite Park. This range lies several miles east and a little south from Empire Meadows. On this trip he watched a mountain coyote attempt to capture a fawn. But the attack was a failure and the doe drove off the coyote.

About June 20, 1909, Parkinson was cruising timber in the red fir belt, 8000 feet elevation, in the country lying between Crown Valley and Spanish Mountain, and between the north and middle forks of the Kings River in Fresno County. Here he saw his first wolverine. It was about 50 yards away in an open space in the timber, working in a loose pile of small rock slabs while trying to catch chipmunks that had taken refuge there.

During the winter of 1911–1912, Parkinson stayed in the mountains all winter at Poison Meadow, several miles south of Shaver Lake. This camp was at the north rim of Blue Canyon and at 6000 feet elevation. It was an ideal location for the temporary winter abode of the big mountain coyote. From here one of these animals could quickly make a trip with little effort to either higher or lower levels. On one occasion he actually counted 22 different lines of tracks where these animals had passed through a certain pass leading to Blue Canyon, all in the same night. After 42 coyotes had been trapped in this immediate vicinity their tracks seemed to be just as plentiful as ever.

In the winter of 1912–1913, in Jose Basin, Fresno County, in an area of about one township, Parkinson caught 26 wildcats. They were more numerous there than at any place he knew in the Sierra Nevada. He thought that not that many were caught in all of Fresno County during 1930–1931.

In his story of the wolverine, Parkinson wrote that in the spring of 1913 he was treated to a rare sight. He visited the summer range of Mr. D. C. Sample, Jr., a cattleman. This range was between Mount Nelson and Patterson Mountain, and between Deer Creek and the north fork of the Kings River. Mr. Sample's cabin was at Long Meadow at 7100 feet elevation. During the previous winter his cabin had been the dwelling place of a large wolverine. The winters then were characteristically severe and at that elevation a snowfall of 15 feet was not uncommon. The cabin had been snowed under when the animal made its entrance by digging through the snow and tearing off shakes near the eaves. In the cabin it tore the bedding and cloth-

ing to shreds and made a nest of them. It scattered provisions and carried off cans of fruit and vegetables, which it dropped in holes where the snow had receded from the boles of trees.

In the fall of 1913, Parkinson and his wife built a cabin one mile north of Mr. Sample's camp, at Red Top Meadow. They went in on September 1 with a complete outfit to spend the winter, to study the winter wildlife of the high Sierra Nevada, and also to trap enough fur to pay the expenses of the trip. In addition to other bait they got five old horses from the mountain cattlemen. These were "placed" in different parts of the range where they expected to trap. Here they caught two wolverines.

About 3 P.M. on November 12, 1913, while the Parkinsons were taking a stroll in the woods west of their Red Top Camp, their fox terrier began "winding" as though he smelled a bear or deer. The animal turned out to be a fisher. It was frightened to the ground and there was a brief, but violent fight with the dog, after which it resumed its travel through the tops of the trees. In December of that year three fishers were caught along this line of travel. Altogether Parkinson trapped ten fishers, and he spent many days snow-tracking them and learning their habits.

For a few weeks each winter from 1915 to 1917 Parkinson trapped predatory animals in the Trabuco Game Refuge in southern California. This refuge lies in the mountains west of Lake Elsinore in Riverside and Orange counties. Parts of the winters of 1916–1917 and 1917–1918, Parkinson spent in Monterey County, where he trapped 133 and 131 gray foxes, respectively. In 40 years he caught over 1200 of these foxes, although he did not trap every year.

In the winter of 1921–1922, Parkinson was trapping marten in the high country at the heads of Grizzly and Iron creeks in Madera County. His camp was at an elevation of 8000 feet and he was trapping up to 9000 feet. A wolverine that lived on these trapping grounds caused him a lot of trouble before it was captured.

In the winter of 1927–1928, Parkinson lived at Toll House in Fresno County. There he made a close study of the ring-tailed cat. Besides capturing 31 of these animals he gathered quite a lot of new information concerning them. His total catch of furs for this neighborhood during that season was as follows: Ring-tailed cat, 31; striped skunk, 25; spotted skunk, 14; wildcat, 1; gray fox, 35; coyote, 3; total, 109. All of these were caught within walking distance of the town. Within the next few years many other persons trapped over the same ground, so that by 1931 it no longer paid to set traps there.

Parkinson kept a diary for many years, but this was burned in 1915, and he had no written records after that; but his memory was remarkably clear and reliable. On a morning (February 25, 1931) spent in the field with me,

he demonstrated again that he possessed an unusually accurate knowledge of the birds and mammals of the region.

Parkinson's death in August, 1931, after a long illness, closed the career of a most remarkable naturalist. The extensive notes which he so freely transmitted to the Museum of Vertebrate Zoology were only a sample of the great number of his observations which would have been valuable if they had been recorded in permanent form.

California Museum of Vertebrate Zoology, Berkeley, California.

THE WOLVES OF NORTH AMERICA

By E. A. Goldman

The wolves of North America have remained very imperfectly known until the present time, owing no doubt to the limited material for study contained in museum collections. Wolves have become extinct over vast areas, including the eastern United States, but have persisted in some of the wilder, more remote regions, especially along the backbone of the continent. The specimens that have accumulated, largely in connection with predatory animal control, now afford a fairly satisfactory basis for determining specific and subspecific relationships.

The true wolves form a compact circumpolar group ranging across North America and Eurasia. In "The Races of *Canis lupus*" (Proc. Zool. Soc. London, pp. 647–686, 1935) Pocock, reverting to the usage of some earlier authors, treated the wolves, including the North American geographic races with the exception of *Canis lycaon* Schreber, as subspecies of *Canis lupus* Linné of Sweden. Geographic considerations and comparison of Old World and New World material seem to warrant this intercontinental linkage of subspecies. Specimens from the Anadyr region, northeastern Siberia, and from Point Barrow, the Yukon River, and other localities in Alaska, are very similar in size, cranial features, and dentition. Evidence of the near relationship of Asiatic and American wolves is not surprising in view of the close approach of the two continents and the possibility that animals marooned on detached ice fields might, under favorable wind conditions, be carried across Bering Strait.

In considering the names of North American wolves, Miller (Proc. Biol. Soc. Washington, vol. 25, p. 93, 1912) showed that *Canis lycaon* Schreber must stand for the animal occurring in eastern Canada. The name was based by Schreber on Buffon's description and figure (Hist. Nat. vol. 9, pp. 362–370, pl. 41, 1761) of a "loup noir," a female, captured in Canada when very young, kept chained, and taken alive to Paris by a French naval officer. Wolves formerly occurred in the vicinity of Quebec, in the southern part of the

province of the same name. This port would have been readily accessible to a French naval vessel, and the vicinity is selected as the type locality of *Canis lycaon* Schreber.

Pocock (loc. cit., p. 684) expressed the opinion that there are very good reasons for doubting that Buffon's animal was a purebred wolf. His reasoning is unconvincing to me; but even if hybridization could be proven, the validity of the fixation by Miller of *lycaon* as the name for the wolf element in the hybrid would not be affected.

Canis rufus Audubon and Bachman, usually regarded as a wolf and included here, exhibits a departure from the true wolves, and in cranial and dental characters approaches the coyotes. The typical region currently assigned by authors to this species is "Texas." In describing the animal, Audubon and Bachman (Quadr. North Amer., vol. 2, p. 242, 1851) quoted an account of its occurrence 15 miles west of Austin, Texas, and for greater precision that place is hereby fixed upon as the type locality. Specimens from the vicinity of Llano and Burnet in adjoining counties to the northwest are regarded as typical.

For the loan of Siberian specimens used for comparison I am indebted to Dr. Roy Chapman Andrews and George G. Goodwin, American Museum of Natural History.

New subspecies of wolves are segregated as follows:

Canis lupus labradorius subsp. nov.

Labrador Wolf

Type.—From vicinity of Fort Chimo, Quebec, Canada. No. 23,136, probably ♀, adult, skull only, U. S. National Museum, collected by Lucien M. Turner in 1882 or 1883. Original number 2190.

Distribution.—Northern Quebec; limits of range undetermined.

General characters.—Size medium; color varying from "dark somewhat grizzly gray to almost white" (Turner manuscript). Similar in general to *Canis lupus lycaon* of eastern Canada, but larger; color apparently lighter; cranial details distinctive. Differing from *Canis lupus tundrarum*, of northern Alaska, in decidedly smaller size.

Skull.—Compared with that of *lycaon* the skull is larger, more massive, but zygomata relatively less widely spreading; rostrum relatively heavier; postorbital region relatively broader (broader than interorbital region in skulls examined); dentition heavier. Not very unlike that of *tundrarum* in general form, but much smaller; postorbital region relatively broader; dentition similar, but rather light.

Measurements.—Skull of type: Greatest length, 247 mm.; condylobasal length, 222; zygomatic breadth, 132.7; squamosal constriction behind zygomata, 73.3; width of rostrum (at constriction behind canines), 42; interorbital breadth, 43.7; postorbital constriction, 46.8; maxillary tooth row, 98.4; upper carnassial, crown length (outer side), 24.7, crown width, 12.6.

Remarks.—Canis l. labradorius is based on only 5 skulls from the region of the type locality. The new form appears to require close comparison only with *lycaon* of the forested region of eastern Canada and the northeastern United States. No specimens of the wolves recently described by Pocock as *Canis lupus arctos* from Melville Island, Arctic America, and *Canis lupus orion* from Cape York, northwest Greenland, are

available for comparison, but identity with either is very unlikely, owing to geographic remoteness.

Canis lupus ligoni subsp. nov.

Alexander Archipelago Wolf

Type.—From head of Duncan Canal, Kupreanof Island, Alexander Archipelago, Alaska. No. 243,323, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by J. Stokley Ligon, November 7, 1922. X-catalogue number 23,022.

Distribution.—Alexander Archipelago and doubtless adjacent mainland of southeastern Alaska.

General characters.—A dark-colored subspecies of medium size. Similar in general to *Canis lupus gigas* of southwestern Washington, but somewhat larger; ratio of blackish to normally colored individuals higher; upper parts in normally colored examples similarly overlaid with black, but usually less suffused with buff; skull more elongated and differing in detail. Much smaller than *Canis lupus pambasileus* of the Mount McKinley region, Alaska, or *Canis lupus occidentalis* of the Fort Simpson region (Simpson near mouth of Liard River on current maps), Mackenzie. Similar to *Canis lupus crassodon* of Vancouver Island, British Columbia, but differs in cranial details, notably the smaller auditory bullae.

Color.—*Type* (winter pelage, November): Short pelage on top of head a mixture of black and white, producing a grizzled effect; upper parts from nape to rump pale buff heavily overlaid with black, the black giving way to purer buff along sides; outer surfaces of legs cinnamon buff (Ridgway, 1912), paling gradually to near pinkish buff on feet; upper surface of muzzle cinnamon buffy; ears rich tawny, mixed with black; under parts in general buffy white; tail above about like back, becoming buffy below and deep black all around at tip.

Specimens from Zarembo and Kuiu islands, closely adjoining the type locality, present two distinct color phases—one which may be regarded as normal, and the other predominantly black. Four of the five skins available from Zarembo Island are in the blackish phase. In the latter the muzzle and feet usually are nearly pure black, but in one a mixture of black and white or gray includes the entire body in a combination suggesting the peculiar color of the glacier bear, which also inhabits the coast region of southern Alaska.

Skull.—Similar to that of *gigas*, but usually larger; rostrum and palate relatively longer; nasals longer, narrower, more gradually tapering posteriorly, the inner margins more strongly turned downward, forming a deeper V-shaped median trough; dentition similar. Much smaller than that of *pambasileus*, but zygomata relatively more widely spreading; dentition relatively lighter. Not very unlike that of *occidentalis* in general form, but very much smaller; auditory bullae relatively slightly larger, more fully inflated; dentition similar, but rather light. Compared with that of *crassodon* the skull is similar in size and general form, but the auditory bullae are decidedly smaller; nasals broader, more divergent anteriorly; dentition lighter.

Measurements.—*Type*: Total length, 1733 mm.; tail vertebrae, 477; hind foot, 300; weight (stomach empty), 91 lbs. An adult female topotype: 1556; 457; 285. *Skull* (type, and an adult female topotype, respectively): Greatest length, 263, 250.7; condylobasal length, 251, 233; zygomatic breadth, 146, 136; squamosal constriction behind zygomata, 80.3, 76.2; width of rostrum (at constriction behind canines), 43.4, 42.9; interorbital breadth, 49.2, 41.4; postorbital constriction, 43.5, 36.5; maxillary tooth row, 114, 108.3; upper carnassial, crown length (outer side), 26.3, 25.4, crown width, 13.9, 13.

Remarks.—The wolf of the Alexander Archipelago is a well-marked form, character-

ized by dark coloration in combination with the cranial features indicated. It appears to be more closely allied to *gigas* than to its huge northern neighbors, *pambasileus* or *occidentalis*, or to the other insular form, *crassodon*, of Vancouver Island.

Specimens examined.—Total number, 27, all from Alaska as follows: Baker Island, 2; Kuiu Island, 2; Kupreanof Island (type locality), 7 (1 skin only); Prince of Wales Island, 8 (6 skulls only); Wrangell, 3 (1 skin only); Zarembo Island, 5.

Canis lupus youngi subsp. nov.

Southern Rocky Mountain Wolf

Type.—From Harts Draw, north slope of Blue Mountains, 20 miles northwest of Monticello, San Juan County, Utah. No. 224,001, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by Bert B. Turner, December 11, 1916. X-catalogue number 17,413.

Distribution.—Formerly southeastern Idaho, southwestern Wyoming, northeastern Nevada, Utah, western and central Colorado, northwestern Arizona (north of Grand Canyon), and northwestern New Mexico. Now restricted mainly to northwestern Colorado.

General characters.—A rather light-colored subspecies of medium size. Resembling *Canis lupus nubilus* of Nebraska, but larger; upper parts more heavily overlaid with black and usually more suffused with buff; skull larger. Similar to *Canis lupus gigas* of southwestern Washington, but upper parts usually less heavily overlaid with black and suffused with lighter buff; frontal profile rising less steeply from rostrum. Differs from *Canis lupus baileyi* of the Sierra Madre of Chihuahua in decidedly larger size, lighter coloration, and cranial details, especially the broader, less depressed rostrum.

Color.—*Type* (winter pelage, December): Short pelage on top of head a mixture of black and light buff; upper parts from nape to rump near warm buff (Ridgway, 1912) moderately overlaid with black, becoming purer buff along sides; outer surfaces of legs warm buff, paling gradually to light buff on feet; upper surface of muzzle light cinnamon buffy, finely mixed with black; ears ochraceous buff, with a blackish admixture near tips; under parts in general light buffy white; tail above light buff, somewhat darkened by black-tipped hairs, becoming light buffy below, and a mixture of black and white all around at extreme tip. Specimens from West Creek and Piceance, Rio Blanco County, and Glade Park, Mesa County, western Colorado, vary in coloration but are regarded as nearly typical. In some the upper parts are more profusely overlaid with black than in the type, and in others the undertone is lighter and lacks the buffy suffusion.

Skull.—Closely resembles that of *nubilus*, but larger; frontal region somewhat less flattened; rostrum more elongated; dentition similar. Similar in size to that of *gigas*, but rostrum less depressed near middle, rising less abruptly to frontal region in side view; palate and nasals usually longer; dentition about the same. Much smaller than that of *occidentalis*; vault of cranium flatter, the frontal profile sloping less steeply; dentition similar. Compared with that of *baileyi* the skull is much larger, but zygomata relatively less spreading; rostrum relatively broader, less depressed; nasals flatter, the inner margins less strongly turned downward; dentition similar, but usually heavier.

Measurements.—*Type* (approximated from tanned skin): Total length, 1800 mm.; tail vertebrae, 470; hind foot, 255. *Skull* (type, and an adult female from West Creek, Rio Blanco County, Colorado, respectively): Greatest length, 259.2, 243; condyloBasal length, 242.8, 231.9; zygomatic breadth, 137.3, 132.4; squamosal constriction behind zygomata, 82.7, 73.6; width of rostrum (at constriction behind canines), 47.5, 42.5; interorbital breadth, 44, 50; postorbital constriction, 40.8, 39.3; maxillary tooth row, 108.2, 106.7; upper carnassial, crown length (outer side), 26.5, 25.2, crown width, 14.5, 13.4

Remarks.—Canis l. youngi is the wolf of the southern part of the Rocky Mountains and the high adjacent plains, displacing *nubilus* west of the prairie region of Nebraska and Kansas. This new form is based on more than 150 skins and skulls from within its general range as outlined. It is named for Stanley P. Young, under whose direction of predatory animal control many of the specimens were taken.

Canis lupus irremotus subsp. nov.

Northern Rocky Mountain Wolf

Type.—From Red Lodge, Carbon County, southwestern Montana. No. 214,869, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection) collected by M. E. Martin, April 19, 1916. X-catalogue number 16,243.

Distribution.—Northern Rocky Mountain region, and high adjoining plains, from northwestern Wyoming north through western Montana and eastern Idaho at least to Lethbridge, Alberta.

General characters.—A light-colored subspecies of medium to rather large size, with narrow but flattened frontal region. Similar in size to *Canis lupus youngi* of the more southern Rocky Mountain region, but whiter, the upper parts less heavily overlaid with black; skull differs in detail, especially in the narrowness of the frontal region. Size larger and color whiter than in *Canis lupus nubilus* of Nebraska, or in *Canis lupus gigas* of southwestern Washington, and differs from both in cranial features, including the relative narrowness of the frontal region. Differs from *Canis lupus occidentalis* of Mackenzie in decidedly smaller size.

Color.—Type (winter pelage, April): Short pelage on top of head light buffy white, the hairs faintly tipped with black; upper parts from nape to rump near light buff (Ridgway, 1912) sparingly overlaid with black, becoming nearly white on sides and limbs; ears and upper surface of muzzle light buffy; under parts in general more or less soiled white; tail above light buffy, thinly and inconspicuously overlaid with black, light buffy below to tip, which is a mixture of buff and black all around.

Skull.—Very similar in size and spread of zygomata to that of *youngi*, but frontal area usually distinctly narrower and flatter, the cranium less convex in upper outline; dentition similar. Not very unlike that of *nubilus* but larger, with relatively narrower frontals. Differs from that of *gigas* in larger size, and in actually as well as relatively narrower frontal region sloping more gradually to rostrum; rostrum and nasals longer. Compared with that of *occidentalis* the skull is much smaller, less massive; upper outline less convex; frontal and postorbital regions relatively narrower; auditory bullae relatively somewhat larger, more inflated; dentition proportionately about the same.

Measurements.—Type (approximated from tanned skin): Total length, 1870 mm.; tail vertebrae, 410; hind foot, 240. *Skull* (type, and an adult female from Dillon, Montana, respectively): Greatest length, 258.5, 245; condylobasal length, 237.4, 226.2; zygomatic breadth, 145.9, 124.1; squamosal constriction behind zygomata, 81.1, 69.5; width of rostrum (at constriction behind canines), 48.2, 41.4; interorbital breadth, 44.9, 41.9; postorbital constriction, 35, 36.8; maxillary tooth row, 106.8, 102.4; upper carnassial, crown length (outer side), 25.2, crown width, 13.4, 14.

Remarks.—Canis l. irremotus is based on more than 30 specimens, chiefly skins with skulls from Montana and Idaho, but the range of the subspecies extends northward along the backbone of the continent to undetermined limits, probably meeting that of *C. l. occidentalis*. Specimens from northwestern Wyoming are somewhat intermediate between *irremotus* and *youngi*. On the east *irremotus* passed into *nubilus*, the somewhat smaller prairie wolf now probably extinct.

Canis lupus monstrabilis subsp. nov.

Texas Gray Wolf

Type.—From 10 miles south of Rankin, Upton County, Texas. No. 209,497, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by W. F. De Long, September 3, 1915. X-catalogue number 12,646.

Distribution.—Southern and western Texas and northeastern Mexico.

General characters.—A rather dark-colored animal of medium size. Resembles *Canis lupus baileyi* of the Sierra Madre of Chihuahua but much larger and usually grayer, less strongly inclining toward buffy or tawny along flanks and on outer surfaces of limbs. Similar in size to *Canis lupus nubilus* of Nebraska, and *Canis lycaon youngi* of the southern Rocky Mountains, but usually darker than either; pelage thinner and coarser; cranial characters, especially the more highly arched frontal region, distinctive.

Color.—Type (summer pelage, September): Middle and sides of face a mixture of black and gray, becoming nearly clear cinnamon buff rather abruptly on top of head; upper parts from nape to rump light buffy in tone, rather heavily overlaid with black, changing to light ochraceous buff (Ridgway, 1912) where the black hairs thin out along sides; outer surfaces of legs light ochraceous buff, paling gradually to light buff on feet; a few dark hairs in a line along external surface of forearm; upper surface of muzzle cinnamon buffy; ears near ochraceous tawny, varied by a few admixed black hairs; chin and edges of lips blackish; throat white; underside of neck a mixture of black and white; rest of under parts dull white, the chest and inguinal region nearly naked; tail above black, mixed with gray, the black predominating, white below to near tip, which is black all around. Other specimens from the type locality vary to nearly white, there being only a trace of the buffy element and the black being reduced to a few inconspicuous hairs along the back and upper surface of tail.

Skull.—Most closely resembles that of *baileyi* in general form, but much larger and heavier; frontal region highly arched and nasals decurved along inner margins as in *baileyi*; rostrum more elongated; zygomata less widely spreading; dentition relatively heavier. Similar in size to those of *nubilus* and *youngi*, but less flattened than either; vault of cranium more highly arched; rostrum narrower, more depressed near middle, sloping upward more steeply to frontals; nasals with inner margins turned more strongly downward, forming a deeper V-shaped median trough; auditory bullae larger, more inflated; dentition about the same.

Measurements.—Type (approximated from tanned skin): Total length, 1620 mm.; tail vertebrae, 423; hind foot, 230. *Skull* (type, and an adult female topotype, respectively): Greatest length, 261, 252; condylobasal length, 237, 228.8; zygomatic breadth, 138, 126.4; squamosal constriction behind zygomata, 81.2, 74.2; width of rostrum (at constriction behind canines), 43.4, 39; interorbital breadth, 45.9, 45.3; postorbital constriction, 39.6, 40.5; maxillary tooth row, 103.2, 103.2; upper carnassial, crown length (outer side), 24.5, 23.4, crown width, 14.2, 14.

Remarks.—Canis l. monstrabilis formerly intergraded toward the north with *nubilus*. Two skulls from the Wichita Mountains, Oklahoma, appear to be intermediate, but are more properly referable to *nubilus*. On the west, in New Mexico, *monstrabilis* intergraded with *youngi*, and farther to the southwest with *baileyi*. Its range meets that of the Texas red wolf (*Canis rufus rufus*) in the central part of the state, but the two are not closely allied. It is distinguished externally from the red wolf by decidedly larger size and more robust form. Compared with that of the red wolf, the skull is much more massive and more highly arched. The dentition is simpler, the upper carnassial has a smaller (often obsolete) antero-internal cusp, and the large upper molar shows less prominent cusp development on the internal lobe. The posterior upper molars are relatively smaller than in *rufus*.

Specimens examined.—Total number, 25, as follows: **Texas:** Big Lake, Reagan County, 1; Kimble County, 1 (skull only); Llano, 1; Monahans, 1 (skull only); Nueces River, Edwards County, 1 (skull only); Rankin (type locality, 10 miles south), 3; Rankin (Harris Ranch, 18 miles southeast), 6; Ozona (N. H. Ranch, 25 miles west), 10: **Tamaulipas:** Matamoros, 1 (skull only).

Canis lupus mogollonensis subsp. nov.

Mogollon Mountain Wolf

Type.—From S. A. Creek, 10 miles northwest of Luna, Catron County, New Mexico. No. 224,548, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by Bart Burnam, July 1, 1916. X-catalogue number 18,119.

Distribution.—Mogollon Plateau region of central Arizona, and east through the Mogollon Mountains to the Sacramento Mountains, New Mexico.

General characters.—A rather small, usually dark-colored subspecies. Similar in general to *Canis lupus youngi* of the Rocky Mountain region to the northward, but smaller and usually darker in color. Decidedly larger and usually lighter in color than *Canis lupus baileyi* of the Sierra Madre of Mexico. Closely allied to *Canis lupus monstrabilis* of Texas, but smaller and with distinctive cranial details.

Color.—Type (worn summer pelage, July): Short pelage on middle of face a mixture of light ochraceous buff and black, becoming ochraceous tawny (Ridgway, 1912) on top of head; upper parts from nape to rump cinnamon buff, rather heavily overlaid with black, becoming purer cinnamon buff on shoulders and along sides owing to thinning of black hairs; outer sides of legs near cinnamon buff, paling to near light ochraceous buff on feet; upper surface of muzzle nearly uniform cinnamon buff; ears ochraceous tawny, mixed with black; throat white; under side of neck white, thinly mixed with black; chest and abdominal region soiled white; tail above about like back, soiled white below on basal two-thirds, becoming cinnamon buff subterminally, and black mixed with white all around at extreme tip. A September specimen from the same locality is similar but somewhat lighter in general tone. A winter example from 20 miles northwest of Chloride, New Mexico, is grayer and approaches the more northern wolves in color.

Skull.—Closely approaches that of *youngi*, but usually distinctly smaller, less massive; zygomata more widely spreading; inner margins of nasals tending to decurve more strongly to form a deeper V-shaped median groove; dentition relatively lighter. Very similar to that of *baileyi*, but much larger. Compared with that of *monstrabilis* the skull usually is smaller, but with zygomata more widely spreading; frontal region less elevated and inflated; auditory bullae smaller; dentition similar.

Measurements.—Type (approximated from tanned skin): Total length, 1770 mm.; tail 440; hind foot, 252. *Skull* (type, and an adult female from near type locality, respectively): Greatest length, 252.9, 241; condylobasal length, 236.9, 222.8; zygomatic breadth, 142.5, 133.8; squamosal constriction behind zygomata, 81.1, 75.5; width of rostrum (at constriction behind canines), 43.9, 44.2; interorbital breadth, 46.2, 46.1; postorbital constriction, 37, 42.4; maxillary tooth row, 107.1, 101.3; upper carnassial, crown length (outer side), 25.1, 24.7; crown width, 14.5, 14.3.

Remarks.—About 120 specimens from the Mogollon Mountain region of New Mexico and westward along the Mogollon Plateau in Arizona are referred to the new subspecies, *C. l. mogollonensis*. This form, now nearly if not quite extinct, is somewhat intermediate in characters as well as in geographic position between *youngi* and the much smaller animal, *baileyi*, which extends north from the Sierra Madre of Mexico into southeastern Arizona and southwestern New Mexico. It combines characters that seem to warrant the segregation of a regional subspecies.

Canis rufus gregoryi subsp. nov.

Mississippi Valley Wolf

Type.—From Macks Bayou, 3 miles east of Tensas River, 18 miles southwest of Tallulah, Madison County, Louisiana. No. 136,731, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by B. V. Lilly, April 25, 1905. X-catalogue number 5338.

Distribution.—Lower Mississippi River basin, mainly the western side, in southeastern Missouri, Arkansas, southeastern Oklahoma, eastern Texas, and Louisiana.

General characters.—A large but slender form of a small species. Closely allied to *Canis rufus rufus* of Texas, but decidedly larger and grayer, less tawny. Similar in size and color to *Canis rufus floridanus* of Florida, but skull more slender; dentition much lighter.

Color.—*Type* (worn pelage, April): Middle and sides of face mixed black and gray, the combination changing to black and cinnamon buff on top of head; upper parts from nape to rump light buff, heavily mixed or overlaid with black; outer surfaces of legs between cinnamon and cinnamon buff (Ridgway, 1912), becoming paler on feet; a conspicuous black line along external surface of forearm; muzzle cinnamon buffy above; ears near cinnamon brown, mixed with black; lips, chin, and throat, white; under side of neck buffy grayish; rest of under parts dull white; tail above similar to back, most of the black-tipped hairs evidently worn off, light buffy below. An adult female from near the type locality is somewhat richer, inclining more toward tawny on muzzle, top of head, and outer sides of limbs.

Skull.—Long and narrow, with little elevation of frontal region. Very similar to that of *rufus*, but much larger, more elongated. Compared with that of *floridanus* the skull is narrower, less robust; rostrum more slender; interorbital region much narrower; dentition very similar but much lighter; premolars smaller, less closely crowded; upper carnassial decidedly smaller, the antero-internal cusp less prominent; large upper molar much smaller, the internal lobe contrasting strongly in weaker, less massive development.

Measurements.—*Type* (approximated from tanned skin): Length, 1626 mm.; tail, 390; hind foot, 242. *Skull* (type and an adult female topotype, respectively): Greatest length, 250, 222; condylobasal length, 228, 202.5; zygomatic breadth, 126, 114.4; squamosal constriction behind zygomata, 73.5, 68.3; width of rostrum (at constriction behind canines), 35.2, 34.2; interorbital breadth, 40.7, 35.7; postorbital constriction, 32.5, 31.2; maxillary tooth row, 104.3, 91.9; upper carnassial, crown length (outer side), 23.5, 22.5, crown width, 11.6, 11.4.

Remarks.—More than 150 skins and skulls from the lower part of the Mississippi River Valley, referred to *C. r. gregoryi*, represent a still living form connecting typical *rufus* and *floridanus*, both of which now may be extinct. A specimen from Cherokee, Colbert County, northwestern Alabama, is somewhat intermediate, but in heavy dentition it is nearer *floridanus*. I take pleasure in naming this subspecies for Tappan Gregory, the author of "The Black Wolf of the Tensas", in recognition of his contribution to our knowledge of the life history of this animal.

Pending the completion and issuance of a more detailed treatment of the group as a whole it seems desirable to publish a revised list of the forms that appear to be recognizable, with the principal synonymy and type localities. No specimens of the subspecies recently described by Pocock (loc. cit.) have been examined, and the forms are included as given by him.

LIST OF SPECIES AND SUBSPECIES OF WOLVES

Canis lupus lycaon Schreber. Vicinity of Quebec, Quebec.
Canis lupus labradorius Goldman. Vicinity of Fort Chimo, Quebec, Canada.
Canis lupus tundrarum Miller. Point Barrow, Alaska.
Syn.—*Canis lupus-albus* Sabine. Fort Enterprise, Mackenzie, Canada.
Canis lupus pambasileus Elliot. Susitna River, region of Mount McKinley, Alaska.
Canis lupus occidentalis Richardson. Simpson, near mouth of Liard River, Mackenzie.
Syn.—*Canis lupus griseus* Sabine. Cumberland House, Saskatchewan.
Canis lupus ligoni Goldman. Head of Duncan Canal, Kupreanof Island, Alaska.
Canis lupus crassodon Hall. Tahsis Canal, Nootka Sound, Vancouver Island, British Columbia.
Canis lupus gigas Townsend. Vancouver, Clark County, Washington.
Canis lupus irremotus Goldman. Red Lodge, Carbon County, Montana.
Canis lupus nubilus Say. Engineer Cantonment, near Blair, Washington County, Nebraska.
Syn.—*Canis variabilis* Wied. Fort Clark, near Stanton, Mercer County, North Dakota.
Canis lupus youngi Goldman. Harts Draw, 20 miles northwest of Monticello, San Juan County, Utah.
Canis lupus mogollonensis Goldman. S. A. Creek, 10 miles northwest of Luna, Catron County, New Mexico.
Canis lupus monstrabilis Goldman. Ten miles south of Rankin, Upton County, Texas.
Canis lupus baileyi Nelson and Goldman. Colonia Garcia, 60 miles southwest of Casas Grandes, Chihuahua, Mexico.
Canis lupus arctos Pocock. Melville Island, Arctic America.
Canis lupus orion Pocock. Cape York, Greenland.
Canis rufus rufus Audubon and Bachman. Fifteen miles west of Austin, Texas.
Syn.—*Canis frustror* Woodhouse. About 100 miles west of Fort Gibson, Oklahoma.
Canis rufus gregoryi Goldman. Macks Bayou, 3 miles east of Tensas River, 18 miles southwest of Tallulah, Madison County, Louisiana.
Canis rufus floridanus Miller. Horse Landing, about 12 miles south of Palatka, Putnam Country, Florida.

U. S. Biological Survey, Washington, D. C.

NOTES ON THE LIFE HISTORY OF THE SNOWSHOE HARE

By C. M. Aldous

A complete life history of the snowshoe hare, *Lepus americanus phaeonotus* Allen, is not attempted here, but rather is it the intention to present information dealing with a few of the lesser-known activities of this animal. These comprise breeding habits, migrations, pelage changes, sex ratio, and homing instincts. Studies were undertaken in the spring of 1932, and were concluded in May, 1935, although trapping and banding operations are still in progress. Much of the work was done at Station-on-Alexander, Cushing, Minnesota, in cooperation with Dr. R. G. Green, of the Medical School of the University of Minnesota. Credit is due Dr. Green and his field men, and also H. J. Spencer, junior biologist, Control Investigations for Wisconsin of the Biological Survey, for their splendid cooperation and assistance.

Longevity.—Little is actually known regarding the normal life span of the snowshoe hare. Klugh (1926) stated: "It is believed to live for eight or nine years." The results of three years of live-trapping and banding operations in Minnesota indicate that only a very few, if any, of these hares reach an age of 8 years. The records from Station-on-Alexander show a total of 454 hares live-trapped, banded, and released in 1932. In 1933 only 70 of the original number were retrapped and released. Fifty-two of the hares trapped in 1932 were taken again in 1934, while in 1935 but 18 of the original hares were caught.

Sex Ratio.—Of the 1625 hares represented in this study, 877, or 54 per cent, were males and 748, or 46 per cent, were females. This sex ratio differs somewhat from what Vorhies and Taylor found for jack rabbits in Arizona, where females outnumbered males. For *Lepus alleni* the ratio was 52.5 to 47.5, and for *Lepus californicus*, 51.5 to 48.5. Whether or not the sex ratio in snowshoe hares will be materially altered after the die-off remains to be determined.

Breeding Season and Rate of Breeding.—According to Grange (1932), it takes a snowshoe hare approximately five months to reach mature weight. That they do not breed the first year is evident from the fact that the first young of the season would not reach maturity until the following September, and no females carrying young have been found later than August. In table 1 is given the results of the examination of 266 pregnant snowshoe hares. As will be seen, these 266 females carried a total of 751 embryos, or an average of 2.84 for each female. Three was the number of embryos occurring most frequently. Females have been examined for pregnancy during every month of the year, but embryos have been found only during March, April, May, June, July, and August. Spencer reported finding a pregnant female hare on March 24, 1934, the earliest record now available for Minnesota or Wisconsin. In this case the embryos were so small that measurement was

practically impossible, indicating that impregnation had but recently occurred. Two other March pregnancies were observed in Minnesota, on March 28 and 31, respectively. In the latter cases also the embryos were too small to be measured. It would seem reasonable, therefore, to assume that breeding among these hares does not occur earlier than about March 15. On August 31, 1931, I killed a female hare at Cass Lake, Minnesota, that carried three fully furred embryos, each having a total length of 9 cm. These young undoubtedly would have been born within a week. All other August pregnancies are recorded as found early in the month, and in every case the embryos were well developed and furred. Thus it can reasonably be assumed that few matings occur later than the first week in August, if the gestation period be approximately 35 days.

Grange (1932) is the only authority on the gestation period of these hares, and he found in the one case observed that 35 days elapsed between the time

TABLE 1

Young Lepus americanus per litter by months as determined by embryo counts

MONTHS	♀♀ WITH 1 YOUNG	♀♀ WITH 2 YOUNG	♀♀ WITH 3 YOUNG	♀♀ WITH 4 YOUNG	♀♀ WITH 5 YOUNG	♀♀ WITH 6 YOUNG	♀♀ WITH 7 YOUNG	TOTAL WITH YOUNG	TOTAL YOUNG	AVER. YG. PER LITTER
March		2	1					3	7	2.33
April	7	12	5	1				25	50	2
May		7	20	11	3	1	2	44	153	3.47
June		18	59					77	213	2.76
July		31	69	6	3			109	308	2.83
August		4	4					8	20	2.5
Totals	7	74	158	18	6	1	2	266	751	2.64
Percentages	2.66	27.8	59.4	6.76	2.25	0.37	0.75			99.99

of conception and parturition. He found also that this same hare mated and conceived 11 days following parturition. If these figures be representative of the average breeding female, it means that 47 days elapse from the time a female breeds until she will conceive again. Using this as a yardstick it would indicate a maximum possibility of four litters during the season. The figures available show that there were only three cases of pregnancies in March and but eight during August. It is reasonable to assume that no animal species breeds at the maximum rate possible; therefore, four litters surely could not be normal for these hares. In the absence of actual data the normal yearly number of litters for each female would appear to be between two and three. Probably two litters would be more nearly the rule than three.

Size of Litters.—The size of the litters of 36 observed females showed the average to be 2.4 young. If the normal yearly number of litters is assumed

to be two, and the normal number of young per litter 2.5, the yearly increase per breeding female would be 5 young.

Klugh (1926) was of the opinion that the snowshoe hare probably produces but one litter of young a year, with an average number of three to four per litter. Seton (1929) stated that "The young are usually 2, sometimes 3 in number." He believed that mating commences early in March and that litters are produced all through May and as late as the first week in June. This does not agree with the findings in Minnesota and Wisconsin.

At Station-on-Alexander, several post-mortem examinations of females carrying small embryos have shown the mammary glands to contain milk, indicating that these females had recently suckled young.

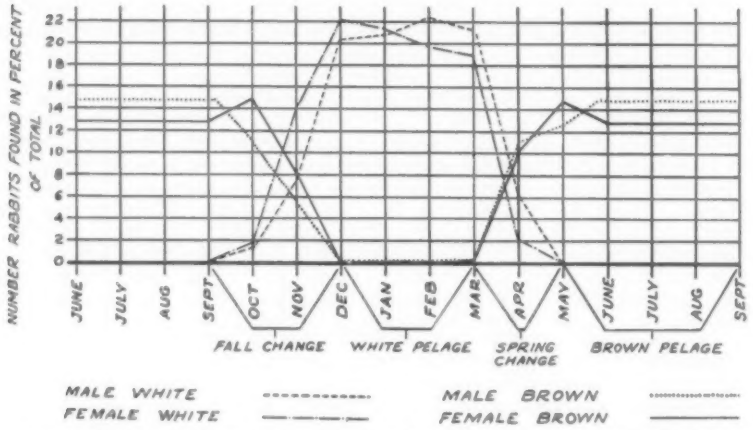


FIG. 1. Sexual and seasonal changes in color, by months, in varying hares, Station-on-Alexander, Cushing, Minnesota.

Taylor stated the average size of litters for *Lepus californicus* to be 2.24 young, while for *Lepus alleni* it was found to be 1.93. The snowshoe hare then has slightly larger litters than do the jack rabbits, but conspicuously smaller than has been recorded for cottontails.

One theory that has been advanced in attempting to account for the rapid increase in rabbit populations during the cyclic build-up is that the number of young to a litter is larger during the build-up than it is just prior to and after each periodic increase. Seton (1929) quoted R. MacFarlane as saying that "A litter usually consists of 3 or 4; but when on the periodic increase, females are known to have as many as 6, 8, and even 10 at a time, and then gradually return to 3 or 4." The results of our work in Minnesota and Wisconsin from 1931 to 1935, in which 266 pregnant snowshoe hares were

examined and the number of embryos recorded, do not substantiate the claim made by MacFarlane.

A rabbit population peak in Minnesota was reached in 1933. In 1931 only 5 pregnant hares were examined and the average litter was 4.8 embryos. In 1932 there was a marked diminution, the litters averaging 3.13 embryos, and in 1933, the peak year, the number of embryos per litter was 3.11, a slight decrease from the previous year. Then, following the peak year, the average litter dropped to 2.77. During 1935 the pregnant females examined averaged 2.65 embryos each, which was a decrease from the previous year. Records for 1934 only were obtained from Wisconsin, and it will be noted that the results checked very well with those from Minnesota. It does appear from the data gathered from 1931 to 1935 that there was a gradual decline in the average number of embryos found in pregnant snowshoe hares, but the

TABLE 2

Young Lepus americanus per litter by months as determined by young born

MONTHS	♀♀ WITH 1 YOUNG	♀♀ WITH 2 YOUNG	♀♀ WITH 3 YOUNG	♀♀ WITH 4 YOUNG	♀♀ WITH 5 YOUNG	TOTAL ♀♀	TOTAL YOUNG BORN	AVER. PER LITTER
April	2	8	6			16	36	2.25
May	1	9				10	19	1.9
June		1	1	4		6	21	3.5
July	1			1		2	5	2.5
August			2			2	6	3.0
Totals	4	18	9	5		36	87	2.4
Percentages	11.1	50.0	25.0	13.88				

decline began before the peak year was reached. Our records certainly do not substantiate MacFarlane's claims of 6, 8, or 10 young, as only two females have been found carrying as many as 7 embryos, one with 6, and only 6 with 5 embryos.

Parental Care of the Young.—The young of the snowshoe hare are born with a coat of hair, the eyes are open, and the young are capable of moving about clumsily a short time after birth. After the second day they can move about quite freely when disturbed, although if not molested they prefer to sit in a huddle perfectly quiet, more or less oblivious to everything about them. Their rate of growth after birth is very rapid, the hares doubling in weight in about 8 days, trebling in about 12 days, and increasing to more than 9 times the weight at birth at one month of age. Grange (1932) determined that for a period of 159 days after birth a young snowshoe hare made an average daily gain of 9 grams.

The instinct for self preservation is well developed in very young hares, for when disturbed while resting in a group they readily scatter to conceal

themselves among the débris, and assume freezing positions, a habit which makes it very difficult to find them. A few hours after their dispersal, however, the litter usually has assembled at the place from which they scattered. The mother seldom interferes or is concerned when the young are handled or removed from the pens. It is believed that the period of parental care is short, a theory corroborated by the fact that a second litter may be born when the first is but 47 days old. From our breeding observations in Minnesota we are inclined to believe that the young are completely weaned by the time they are a month old. Grange (1932) reported that one of the young born in captivity in Wisconsin began to nibble lettuce at 8 days of age. Solid foods very rapidly replace milk in the diet of these young hares.

Nests and Forms.—Seton (1929) stated that he has never found a snowshoe hare's nest in the wild state, but that he is inclined to believe that they, like their near relatives the jack rabbits, do not make a nest for depositing their young. Klugh (1926) was of the opinion that snowshoe hares construct nests of grass and leaves lined with fur from the mother's breast, and that she uses the fur as a blanket to cover the young when she leaves them. Audubon and Bachman (1848), and Cory (1912), reported that a nest is constructed of grass and straw and is lined with fur or hair from the body of the mother.

Grange (1932) found not the slightest evidence of any tendency on the part of his captive female hares in Wisconsin to pluck hairs for nest lining, nor was there any tendency toward nest construction. The findings in Minnesota, with 37 cases observed, are in accord with those of Grange. Sometimes the young are dropped in the form used by the female, but just as frequently they are to be found wherever cover is available. In not a single instance was hair, fur, grass, or leaves found as a lining or blanket upon which the young were dropped.

Forms.—Forms are regularly used by snowshoe hares throughout the year. They are found in such places as high dry grass, at the base of willow clumps, in hollow logs, and under logs or fallen trees. They are seldom found in exposed open spaces. The forms are merely resting places located in secluded spots where the hares spend the major part of the day, during which time they are largely inactive. During inclement weather, such as high winds, rain, and snowstorms, they remain fairly close to these forms. As a rule the form is personal property and other hares seldom trespass. The writer confined 11 females in a quarter-acre fenced plot in a forested area in Minnesota, and it was a common occurrence for him to come to this plot any time during the day and to find every female, after once having learned the location of the form belonging to each animal. Several of these individuals had peculiar markings which permitted positive identification of the animals. Each hare, doubtless, may have more than one form, but it is very doubtful if they do a great deal of interchanging of forms. During windy weather the hares sit in the forms, facing the wind. This posture keeps the fur in place and minimizes chilling.

Physical Characteristics in the Breeding Season.—That the testes of the male hare undergo marked changes in size and position throughout the year is attested by the accompanying illustrations made from actual photographs. It will be noted that in January the testes are very small and somewhat kidney-shaped. At this period they are in the abdominal cavity. In February a marked increase in their relative size and shape is observed, but their position is still intra-abdominal, at least during the early part of the month. Near the last of the month, however, they descend into the scrotum. In March they have about reached maximum size, and by April they are fully distended and remain so through May and June. In July they begin rapidly to decrease in size, reaching the minimum by September, when they again retreat into the body cavity, where they remain until the following March.

Out of breeding season the penis appears very pale, almost completely white. Just before mating commences the tip of the penis becomes bright red, and by the time this is well under way the penis is red all over. After the breeding season is past the red color disappears entirely. The penis of first year males remains pale throughout the year. It is certain that they do not mate until the second year.

The mammae of the females are six in number, one pair pectoral and two pairs abdominal. Even while the female is suckling its young, the mammae are to be located only by running the hand along the under side of the body.

It has been observed that soon after conception females exhibit an enlargment of the vulva with purplish coloration of the mucosa. After parturition is over for the season, the vulva returns to normal size and a natural flesh-pink coloration.

Dusting Places.—Snowshoe hares make extensive use of dusting places, usually located where sunlight can reach them. The dust bath, unlike the form, is believed to be used indiscriminately by the hares of the neighborhood and also by ruffed grouse. The hares enjoy stretching and rolling in the dry fine dust. Because of the large number of ticks that infest these hares in summer, it is highly probable that they use these dust baths to lessen the annoyance caused by the ticks.

Pelage Changes.—Observations on the color change of snowshoe hares during the fall and spring months of this study were recorded as individual observations and not as the number of individual hares observed. In order to simplify the matter of the degree of color change, each individual observation made was recorded as either white-brown, brown-white, white or brown.

In January practically all of the hares are pure white; the same statement holds true for February; but in March, although the hares are predominantly white, a large number have changed to white-brown, a lesser number show brown-white, and a few are pure brown. Females tend to discard the white guard hairs and enter the brown stage sooner than do the males. In April there are but few pure white hares, the greater number having reached the

FIG. 2

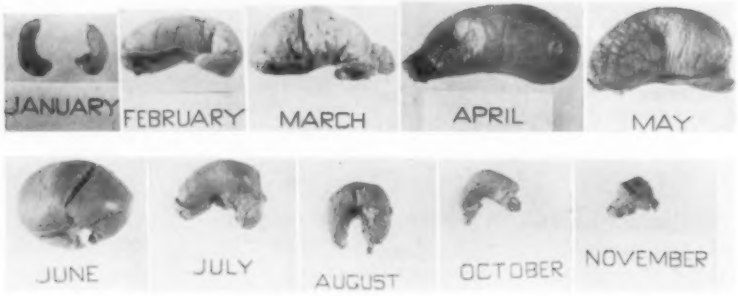


FIG. 3

FIG. 2. Ear-tagged varying hare (*Lepus americanus phaeonotus*), Cass Lake, Minnesota, 1932. Courtesy of L. B. Ritter. FIG. 3. Physical changes in the testes of varying hares in and out of breeding season, arranged to illustrate progressive changes. Reduced one-half.

brown-white stage and nearly as many are entirely brown. By May all hares are brown. No trapping was done during June, July, August, or September, but during these months brown is the dominant color. During October there were 2 white, 11 brown-white, and 18 brown hares observed. In November the color shifts rapidly from the brown to the white, and in December practically all individuals are white.

The accompanying graph illustrates the rate of color change by sex each month of the year. These data represent 2183 color observations made in the field. To simplify the problem the white and white-brown colors were combined and listed as white, and the brown-white and brown were combined as brown. The figures in the graph were transposed to a percentage basis. Because no trapping was done in the summer months and because it is known that these hares are brown at that time, it was necessary to supply figures for the summer months based on the known sex ratio. This graph clearly shows that in Minnesota the period of white color is shorter than that of the brown, and it takes longer to complete the color change in the fall than in the spring. The figures also show that females tend to complete the spring change earlier than do the males, and in the fall the females also tend to complete the change to white sooner than do the males.

Migrations.—Prior to the beginning of the trapping and banding operations in the fall of 1932 at Station-on-Alexander, Cushing, Minnesota, few data were available dealing with the daily or seasonal movements of snowshoe hares. Dr. R. G. Green, in connection with his disease investigations, was also interested in the cruising radius of these animals, and through a working relationship with him a plan was evolved whereby it would be possible to make migration studies on this area. The Bureau of Biological Survey cooperated in this study by supplying the aluminum ear tags for marking the live hares, and by furnishing a man to survey and type-map the area. The area was marked off in 40-acre squares. Metal markers, designating trapping stations by numbers, were nailed up in all the swamps. These markers were also located accurately on the type map, which was constructed on a scale of one inch to one-eighth mile. Sixty metal live traps were used. Trapping operations were continued from October until May. The traps were visited once each day for the purpose of tagging and releasing the captive hares, and for moving, resetting, and making any adjustments of the traps considered necessary. Cured green alfalfa hay was successfully used to bait the traps during the fall, winter, and early spring. A permanent record card was kept for each hare taken. These cards show the date of capture, place of capture, place of release, date of release, sex, number of times taken, and such other information as color phase, ticks, fleas, and abscesses. To date there are on file these data for every hare that has been trapped or retrapped on the entire area. They represent the basis for determining the movements or migration tendencies of the hares. The records for only the first 1625 tagged

animals were used in this study. Of these 1625 hares, 877 were males and 748 were females, a sex ratio of 54 to 46. Table 3 is a record of these animals, showing the number of first catches and each subsequent retrap.

It will be noted that 772 of these hares were taken but once, while 853 of the original number entered the traps two or more times. It was from the

TABLE 3

Trap and retrap record, 1932–1935

NO. OF HARES TAKEN	NO. OF MALES	NO. OF FEMALES	RETRAP NO.	TOTAL	NO. SHOWING NO MIGRATION	NO. SHOWING MIGRATION
1 time	407	365	0	772	0	0
2 times	186	163	1st	349	236	113
3 times	123	103	2d	226	125	101
4 times	68	58	3d	126	62	64
5 times	44	33	4th	77	39	38
6 times	17	14	5th	31	12	19
7 times	12	6	6th	18	4	14
8 times	12	4	7th	16	3	13
9 times	4	1	8th	5	1	4
10 times	3	0	9th	3	0	3
11 times	0	0	10th	0	0	0
12 times	0	0	11th	0	0	0
13 times	0	1	12th	1	0	1
14 times	1	0	13th	1	0	1
Totals.....	877	748		1625	482	371

TABLE 4

Migration records

MIGRATION DISTANCES	NUMBER OF TIMES		TOTAL
	Male	Female	
$\frac{1}{8}$ mile	200	133	333
$\frac{1}{4}$ mile	39	44	83
$\frac{3}{8}$ mile	11	7	18
$\frac{1}{2}$ mile	11	5	16
$\frac{5}{8}$ mile	2	3	5
$\frac{3}{4}$ mile	2	10	12
$\frac{7}{8}$ mile	1	0	1
1 mile or more	10	5	15
Totals.....	276	207	483

records of the retrapped hares that it was possible to obtain the data relative to their movements. It will be noted that 482 of the 853 retrapped hares showed no migration, they having been retrapped at the original stations, while 371 of them showed they had moved approximately one-eighth mile

from the place where they were taken originally. An examination of the figures shows that sex evidently had little influence on the tendency of an animal to be retrapped one or more times. Up to the seventh time taken the tendency to retrap decreased very uniformly, after which it was erratic, although the number of animals taken from the seventh and to the thirteenth time diminished to zero.

Table 4 is a compilation of all the recorded migrations made by the 371 migrating hares. The movements are shown by distances of one-eighth mile units. Any distance nearest an inch on the map was called one-eighth mile, any distance nearest two inches on the map was called one-fourth mile, and so on up to a mile, after which all migrations greater than that were grouped together. The migrations as recorded in the table show that by all odds one-eighth mile was the most common distance traveled. The 333 movements of one-eighth mile represent 69 per cent of the total number of the migrations, while 17 per cent of the total movements were one-fourth mile in extent, leaving the remainder of the greater distances to aggregate only 14 per cent. By table 3 it will be noted that 482 hares were retrapped one or more times without showing movement. When this fact is coupled with the large percentage of hares that moved only one-eighth mile, it becomes apparent that the normal cruising radius is very small, or at least is limited to only a few acres. These findings are in close accord with the statement by Grange (1932), in which he said: "I have followed one hare for an hour and fifteen minutes during which time it could not be driven from an area perhaps ten acres in extent, and in which time it returned to within five feet of the original point." Seton (1929) also was convinced that the homing territory of the snowshoe hare is very restricted. Klugh (1926) stated: "I am inclined to think that at most a few acres represent the home range of a single hare."

Table 4 shows that 57 per cent of the migrations were made by male hares. This percentage is only slightly higher than the sex ratio of males to females of all hares taken, of which 54 per cent were males. On a previous tabulation, made to determine migration direction trends, it was shown very clearly that the migrating hares moved without any definite direction trend.

Retrap Tendencies.—It was found that of the 1625 hares trapped, 454 were trapped in 1932; that 70 of these were taken again one or more times in 1933; that 22 of them were taken in both 1933 and 1934; and that four of the original 454 were taken in 1933, 1934, and 1935. During 1933 a total of 797 new hares were taken; of this number 152 were taken again in 1934; and 33 of the 152 were taken yet again in 1935. It was discovered that some of the hares first taken evaded the traps for a year or two before being trapped again. It was interesting to note that 30 of the hares trapped in 1932 skipped 1933, and were retaken in 1934. Twenty of the 1933 hares skipped being taken in 1934, but were caught again in 1935. Five hares of the 1932 catch

evaded the traps during 1933 and 1934, to be taken again in 1935. Seven hares that were taken in 1932 were taken again in 1934, having missed the traps in 1933, and were taken still again in 1935. Only two hares were taken in 1932 and 1933, missed 1934, and were taken again in 1935.

Homing Instincts.—When the trapping and banding operations first started at the Station-on-Alexander in the fall of 1932, the captive hares taken from all the trapping stations were released at one common point known on the records as Green's Island. This so-called island is surrounded on three sides by the waters of Lake Alexander and on the fourth side by a wet boggy swamp that separates it from the mainland. Well over 100 hares were liberated here before the practice was discontinued in favor of releasing them at the points of capture. Although some of the hares lingered on the island, a great many of them made their way back to the place where originally they were caught.

It was interesting to note that the hares would seldom chance leaving the island for the mainland on nights when it was clear weather, but preferred to wait until cloudy nights rendered it advantageous for them to move with some degree of safety. On one occasion it was very evident from tracks seen in newly fallen snow that several of the hares had left the island, gone out over the lake a distance of about 50 or 60 feet only to reverse their direction and return to safety under the brush covering the land. On dark nights the hares did not hesitate to make the trip to the mainland, a distance of about one-eighth mile. There is no doubt that these animals fear their many natural enemies while exposed in open spaces. Eighteen of the hares returned a distance of one mile or more, while 34, which was the largest number, returned one-half mile. It was from these two distances that most of the hares were taken from their home grounds to be released on the island. At the close of this practice of releasing on Green's Island many of the hares were taken three miles away and released, but none of these were ever recovered, so it is unknown whether any of them succeeded in returning. When released at one and one-eighth miles away, these hares had little difficulty in reaching their home grounds. All captive hares were carried in sacks from the point of capture to the laboratory and then to the island where they were released. They were given no opportunity of seeing the direction in which they were being taken, yet in spite of this, many of them made their way back, usually in less than a week's time. F. Gillett (1934) stated: "Rabbits trapped within three-eighths of a mile of headquarters and released at headquarters would find their way back to their original haunts." It would seem, in the light of our findings and those of Gillett, that these animals tend to return to their home grounds when released at a point not much farther than a mile away.

One interesting case at the Station-on-Alexander was observed: A male hare, no. 471, was taken in a figure-4 trap seven times between January

31 and March 17, 1932. After each capture this hare was carried one-half mile away, where he was released on Green's Island. The interval in days that elapsed between each release and subsequent retrapping at the original station was 7, 8, 15, 6, 4, and 5, respectively. This hare, whenever caught, fought the trap by plunging against the wires of the sides and end in an endeavor to escape. In so doing it succeeded in peeling the skin of the face from the nostrils to the base of the ears. After the seventh time in this trap he was carried to the three mile point and released, and was never retrapped.

LITERATURE CITED

AUDUBON, J. J., and J. BACHMAN. 1851. Quadrupeds of North America. Vol. 1, pp. 93–106.

BAKER, F. S., C. F. KORSTIAN, and N. J. FETEROLF. 1921. Snowshoe rabbits and conifers in the Wasatch Mountains of Utah. Ecol., vol. 2, pp. 101–108.

GILLETT, F. C. 1934. Michigan Dept. Conservation Monthly Bull., vol. 4, no. 2.

GRANGE, WALLACE B. 1932. Observations on the snowshoe hare, Lepus americanus phaeonotus Allen. Jour. Mamm., vol. 13, pp. 1–19.

KLUGH, A. B. 1926. The life of the varying hare. Nat. Mag., vol. 7, pp. 228–230.

SETON, E. T. 1929. Lives of game animals. Vol. 4, pp. 441–587.

SOPER, J. D. 1921. Notes on the snowshoe rabbit. Jour. Mamm., vol. 2, pp. 101–108.

VORHIES, C. T., and W. P. TAYLOR. 1933. The life histories and ecology of jack rabbits, Lepus alleni and Lepus californicus, in relation to grazing in Arizona. Tech. Bull. no. 49, Arizona Exper. Sta., pp. 471–587.

U. S. Biological Survey, University of Maine, Orono, Maine.

WINTER RODENT DAMAGE TO GAME COVER

BY HILBERT R. SIEGLER

The severe winter of 1935–1936 left in its wake a noticeable degree of rodent damage to woody plants on the Faville Grove Wildlife Area near Lake Mills, Jefferson County, Wisconsin. In March and April, 1936, there was made a study of this damage. The main objective was to explore the relationship between game birds and rodents, and the capacity of the latter as destroyers of cover. The area is deficient in cover; hence rodents, to the extent that they inhibit the growth and spread of woody plants in woodlots and fencerows, reduce the carrying capacity for game. The survey was productive of more questions than solutions.

Mice and Rabbits.—Most of the damage to the woody plants of this area could be traced to either the cottontail rabbit (*Sylvilagus floridanus mearnsii*), the meadow mouse (*Microtus pennsylvanicus*), or the deer mouse (*Peromyscus leucopus*). It was difficult to determine which mouse played the major rôle, but in all probability it was the *Microtus*, because this mouse was especially abundant during and previous to the investigation. It was less difficult

to establish the difference between mouse and rabbit damage. If the gnawed portion commences at the base of tree or shrub, the blame generally can be placed upon the mouse. Occasionally, however, the mouse starts its gnawing higher on the trunk. The decided difference in tooth marks and the style of gnawing can then be relied upon to establish the source of the gnawing. A single, chisel-like groove about 2.5 mm. in width matches the lower incisor of a rabbit. A double-grooved incision about 1.5 mm. in width identifies the work as that of a mouse. The work of the rabbit is ragged and irregular, the incisions being either shallow or deep. The location of the marks is usually desultory, a patch here and another there. The mouse, on the other hand, does a neat job; the gnawing seldom is patchy and an even depth is maintained throughout. A ring of mouse droppings around the base of the tree often furnishes the final clue.

A review of the data reveals that mice did more damage than rabbits, for the following reasons: the mouse restricted its gnawing to plants of greater value to game; the rabbit usually pruned or scarred (we shall use the term "scarred" wherever the stem has been gnawed but not girdled); the mouse girdled more often than scarred. Thus, in one patch, it was found that of 182 saplings of plum (*Prunus nigra*), 19 were girdled and 6 scarred, all by mice. In one case a plum tree 6 feet high had been girdled from base to tip.

The following plants ranked as preferred mouse food: wild black cherry, wild plum, gooseberry, blackberry, apple, and various oaks.

The cottontail, on the other hand, scarred a greater variety of trees. Even smooth sumac, in every case the favorite plant of the rabbit, showed little girdling. Of about 3100 stalks in a patch of sumac 100 feet from a dense rabbit cover, about 320 were either pruned, budded (the rabbit gnaws off a number of buds without taking any other part of the plant), or scarred. Only three stems were girdled. In short, only about 10 per cent of the stalks were touched by rabbits, and only 3 stalks were definitely ruined. A re-check during the summer revealed that practically all of the scarred and pruned sumac had survived. On this area rabbits inflicted the heaviest damage on blackberries and wild rose by pruning these down to the surface of the snow. In many instances local farmers had blamed rabbits for the mouse damage.

Buffers.—Trippensee (1934) stated that cut brush "protects young growing stock, such as small hardwood trees or orchard trees, by giving a more easily accessible food of equal palatableness." My findings seem fully to substantiate his assertion. In one instance a farmer had cut wood, leaving the freshly-cut branches stacked in the form of scattered brush piles. These branches were stripped of bark by rabbits, but the surrounding shrubbery and saplings were scarred in only a very few instances. Did the rabbit prefer to do its gnawing while under cover, or was the horizontal position of the branches more to the rabbit's liking? In any event, these brush piles acted as a buffer to protect the living undergrowth. In two other places on the area,

rabbits used fresh brush piles as sanctuaries without material damage to surrounding woody plants.

Brush piles need not be the only buffers. Feeding stations, in which corn is offered, might take the place of brush piles; but this theory was not tested thoroughly.

A number of conifer plantings had been made on the area studied. Most of these consisted of white spruce. Of 1875 spruce, 312 had been de-budded, presumably by rabbits. Usually the terminal bud was removed. In one case, a number of white spruce had been planted around sumac and blackberries. The latter were scarred and pruned by rabbits, but not a single spruce had been touched. Can sumac, blackberry, and other palatable shrubs be used as buffers to protect conifers? It might be well here to quote an unsigned paragraph appearing in the Pennsylvania Game News of August, 1934: "J. W. Hershey, a nurseryman of Downington, and others have found by extensive experience that planting soy beans near your trees and leaving a patch of them to stand over winter, will keep rabbits from gnawing shrubs and trees."

Soil Differentials in Palatability.—The survey brought to light some instances of differential damage that cannot be ascribed to buffer action, or to any aspect of palatability as between species. They seem to indicate differential palatability *within the species* induced by soil differences, perhaps of the kind described by Mitchell and Hosley (1936) for deer. They found that nitrogen fertilizer radically changed the palatability of dogwood. One such instance was noted on a hillside covered with sumac and undergrown with blackberry and rose. There was sanctuary cover at the bottom, but the sumac scars (50 per cent of the stems) were confined to the top, while the rose and blackberry work was evenly distributed.

Again, at the juncture of four fields, spruce, rose, and viburnum had been planted in all four fence corners. In two of the corners all the plants were pruned by rabbits, whereas in the other two only one-half the plants were pruned. No sanctuary cover was near. Does the answer lie in previous differential treatment of the soil in the four fields?

Rodent-proof Species.—Leopold (1933) called attention to the findings of Carlos Bates of the U. S. Forest Service: "Several races of western yellow pine were planted at the same time in adjacent plots of similar soil, exposure, etc., in the Fremont Forest Experiment Station, in Colorado. Local deer, browsing in the plots, showed a decided preference for the Black Hills race of pine. The most probable explanation is differing chemical composition." If there are differentials in palatability as between geographic races, it should not be far-fetched to believe that the game manager can use species differentials in selecting planting stock. This survey brought to light the fact that a number of plant cover species nearly always are unpalatable to both mouse and rabbit. With only one or two exceptions, frost grape and Virginia

TABLE 1

Plants found damaged by rodents

TREES	SHRUBS
Tame apple (*Malus* sp.)	Bittersweet (*Celastrus scandens*)
Wild apple (*Malus malus*)	Blackberry (*Rubus* sp.)
Crab apple (*Pyrus coronaria*)	Cranberry (*Viburnum americana*)
Mountain ash (*Pyrus* sp.)	Cranberry (*Viburnum opulus*)
Big toothed aspen (*Populus grandidentata*)	Garden currant (*Ribes rubrum*)
American aspen (*Populus tremuloides*)	*Alternate-leaved dogwood (*Cornus alternifolia*)
Basswood (*Tilia americana*)	*Panicled dogwood (*Cornus paniculata*)
*Swamp birch (*Betula pumila*)	*Red-osier dogwood (*Cornus stolonifera*)
Butternut (*Juglans cinerea*)	*Elder (*Sambucus canadensis*)
Red cedar (*Juniperus virginiana*)	*Hazelnut (*Corylus americana*)
Black cherry (*Prunus serotina*)	Gooseberry (*Ribes* sp.)
Cottonwood (*Populus balsamifera*)	Domestic grape (*Vitis* sp.)
Box elder (*Acer negundo*)	*Frost grape (*Vitis vulpina*)
American elm (*Ulmus americana*)	*Honeysuckle (*Lonicera* sp.)
Hawthorne (*Crataegus* sp.)	Jersey tea (*Ceanothus americanus*)
Shagbark hickory (*Carya ovata*)	Meadow sweet (*Spiraea* sp.)
Pignut hickory (*Carya glabra*)	Raspberry (*Rubus* sp.)
Bitternut hickory (*Carya cordiformis*)	Wild rose (*Rosa* sp.)
Ironwood (*Ostrya virginiana*)	Poison sumac (*Rhus vernix*)
Honey locust (*Gleditsia triacanthos*)	Smooth sumac (*Rhus glabra*)
Red maple (*Acer rubrum*)	Staghorn sumac (*Rhus typhina*)
Silver maple (*Acer saccharinum*)	Sweetbrier (*Smilax hispida*)
Sugar maple (*Acer saccharum*)	*Virginia creeper (*Parthenocissus quinquefolia*)
Black oak (*Quercus velutina*)	Winter berry (*Ilex verticillata*)
Burr oak (*Quercus macrocarpa*)	
Red oak (*Quercus borealis*)	
White oak (*Quercus alba*)	
Norway pine (*Pinus resinosa*)	
White pine (*Pinus strobus*)	
Wild plum (*Prunus nigra*)	
Norway spruce (*Picea abies*)	
White spruce (*Picea glauca*)	
Tamarack (*Larix laricina*)	
Willows (*Salix* sp.)	

* Damage was found in rare cases only. These plants are believed to be almost immune.

TABLE 2

Plants favored by rodents

BY RABBIT	BY MOUSE
Smooth sumac (*Rhus glabra*)	Wild black cherry (*Prunus serotina*)
Blackberry (*Rubus* sp.)	Wild plum (*Prunus nigra*)
Raspberry (*Rubus* sp.)	Gooseberry (*Ribes* sp.)
Oaks (*Quercus* sp.)	Oaks (*Quercus* sp.)
Wild black cherry (*Prunus serotina*)	Blackberry (*Rubus* sp.)
Rose (*Rosa* sp.)	Apple (*Malus pumila*)

creeper remained untouched. Elder was seldom touched. One sumac, surrounded by a thicket of pannicled dogwood, was practically devoured. The dogwood remained untouched. A hazelnut thicket in the midst of a scarred stand of sumac was untouched. Swamp birch is generally considered a deer delicacy, but in only a few instances was it touched by rodents, although it is abundant in the swamps of this area.

If later experience verifies the findings of this year, we can safely say that red cedar, creeping juniper, the poplars, elder, hazelnut, the various dogwoods, swamp birch, Virginia creeper, frost grape, and honeysuckles can be planted with reasonable expectation of freedom from rodent damage. A number of plants doubtless will be added to this list in the course of future investigations.

A summary list of the woody plants found damaged appears in Table 1, and a list of those preferred by rabbits and mice respectively appears in Table 2.

LITERATURE CITED

BAILLIE, JAMES L. 1935. Some notes on the cottontail in Ontario. Canadian Field-Nat., vol. 49, pp. 70–71.

HATT, R. T. 1930. The biology of the voles of New York and the relation of mammals to the Harvard Forest. Roosevelt Wild Life Bull., vol. 5, no. 4, pp. 513–671.

LEOPOLD, ALDO. 1933. Game management. Scribner's, New York.

MITCHELL, H. L., and N. W. HOSLEY. 1936. Differential browsing by deer on plots variously fertilized. Black Rock Forest Papers, vol. I, no. 5, pp. 24–27.

TRIPPENSEE, R. E. 1934. Cottontail in relation to cover. Amer. Game, Sept.–Oct., Nov.–Dec., Jan.–Feb.

WIEGAND, KARL M., and ARTHUR V. EAMES. 1925. The flora of the Cayuga lake basin, New York. Memoir 92, Cornell Univ. Agric. Exper. Sta., Ithaca, N. Y.

Division of Game Management, University of Wisconsin, Madison, Wisconsin.

NOTES ON THE LIFE HISTORY OF THE ROOSEVELT ELK IN CALIFORNIA

By Robert T. Orr

The Roosevelt elk (*Cervus roosevelti*) (Bailey, Proc. Biol. Soc. Wash., vol. 48, p. 187, 1935) formerly ranged throughout northwestern California from the Oregon line south to the northern side of San Francisco Bay. Today but a small group of these animals remains in this state, principally in extreme northern Humboldt County. Although this species is not uncommon in parts of Washington and Oregon, it seems worthwhile to record any information that may be obtained concerning its habits and abundance at the southernmost extremity of its present range, where it is slowly approaching extinction. The following brief notes were gathered between October 17 and December 19, 1935, while I was working for the National Park Service in northern Humboldt and southern Del Norte counties, California. Where it has seemed advisable, information is included which has been furnished by certain local residents of this region who have observed these animals for many years.

Habitat.—The majority of the Roosevelt elk in California now inhabit the country within 3 or 4 miles of the coast, between the mouth of Redwood Creek, Humboldt County, and the Del Norte-Humboldt county line, some 12 miles to the northward. A small percentage of the total population occurs outside of this defined area, principally in southern Del Norte County.

The occupied territory is principally forest land. Inland this cover consists chiefly of redwood (*Sequoia sempervirens*), Douglas fir (*Pseudotsuga taxifolia*), and coast hemlock (*Tsuga heterophylla*), while adjacent to the coast it is composed entirely of tideland spruce (*Picea sitchensis*). The small, forested valley of Prairie Creek, a tributary of Redwood Creek, extends through the center of the area parallel to the coast. Along the course of this stream there are a number of small, grassy clearings, surrounded principally by salmon-berry (*Rubus spectabilis*), which seemingly prove attractive to elk during the late spring, summer, and early autumn months. Single individuals or small groups were not infrequently observed in such situations during the latter half of October and the early part of November before the leaves had fallen from the salmon-berry.

After the leaves have fallen from this dense brush and it is no longer capable of providing either food or shelter, the elk appear to move from this valley and the adjacent ridges toward the coast, where a number of individuals are reported to remain throughout the year. Here they inhabit the spruce forests and the dense coastal brush, composed mainly of salal (*Gaultheria shallon*) and huckleberry (*Vaccinium ovatum*), interspersed with occasional thickets of young spruce.

Food.—No definite browsing places were observed, although this method of

feeding certainly does occur to a large extent along trails and around the margins of clearings. Protected grassy clearings, wherever present, showed obvious signs of being kept closely cropped. Judging from what was observed and from the statements of residents, Roosevelt elk feed in the evening and early morning as do the black-tailed deer (*Odocoileus columbianus*). A considerable portion of the night also is probably spent feeding. Occasionally individuals were seen feeding in the daytime.

The following species of plants were found to constitute an important part of the food of Roosevelt elk in this region: sword fern (*Polystichum munitum*), deer fern (*Lomaria spicant*), bilberry (*Vaccinium parvifolium*), huckleberry (*Vaccinium ovatum*), salal (*Gaultheria shallon*), salmon-berry (*Rubus spectabilis*), wild lilac (*Ceanothus thrysiflorus*), willow (*Salix* spp.) and various grasses. This list, undoubtedly, could be greatly increased in spring and summer when many annuals are present. Sword fern is reputed to form an important item of food for elk during the spring, summer and autumn months. Usually the entire plant is uprooted and the young fronds are eaten. This was frequently observed during the month of October, whereas in November and December these plants were rarely seen to have been touched. Salmonberry is an important item of browse during this same period. Wild lilac apparently is eaten during the entire year and seems to be one of the plants preferred by elk. Huckleberry is less desirable as a food than the closely related bilberry. This might possibly be attributed to the softer foliage possessed by the latter species. The cut and broken stems of bilberry and lilac plants indicated that these species are browsed to a height of 6 feet above the ground.

Cultivated crops, such as corn and barley, appear to be particularly attractive to elk during May and June. This information was volunteered by a number of local people. During this period the elk frequently cause owners of small farms a great deal of trouble, especially where crops are located near forested land.

Habits and Behavior.—It was my impression that Roosevelt elk fail to show the same distrust of man as normally is exhibited by deer. Individuals that were encountered while feeding or resting did not bound away but usually walked off sedately or trotted until they came to a rise, from which vantage point they could view their pursuer. A number of the elk that were encountered were reluctant to move far. When disturbed during the middle of the day, especially in thickets of young spruce surrounded by an ample cover of brush, the aroused animals often arose and moved around the thickets so as to keep from sight, instead of attempting to run off.

It seems probable, at least during the winter months, that these elk tend to travel together in small bands, usually composed of one or two bulls and three or four cows and their calves. This is the manner in which they most often were seen. Likewise, during December, two or three of these small

herds were frequently found congregated relatively close together in such spots as near the mouths of creeks along the coast, where forage and cover were more suitable than elsewhere. The relationship between these herds during other seasons of the year is unknown. The individuals noted singly usually proved to be bulls.

Well defined trails are regularly used. In territory commonly occupied by elk, nearly every ridge was found to have a main trail extending along its crest. Smaller lateral trails branched from these and led down the sides of canyons. Rarely were there trails in the bottoms of small ravines where brush was very dense. The larger canyons which possessed flowing water and occasional clearings, however, often had an elk trail running parallel to, and not more than a short distance from, the stream.

Along the coast in this vicinity there are precipitous bluffs rising to a height of a hundred feet or more above the beach. Quite frequently at the base of these bluffs there is a small amount of grassland sloping to the sand. Because of the steepness of the bluffs, the only places where access can be had to the forest above are at the mouths of small creeks, which are separated from each other by distances varying from one-half to over one mile. Since these grasslands are used for feeding by elk there are definite trails leading along the bases of the cliffs from one canyon mouth to the next. These paths are very well defined, being not unlike cattle trails, and invariably tend to stay as close as possible to the cliffs. Tracks occasionally were found leading across the beach almost to the water's edge.

Elk beds, where individuals remain during resting hours, are frequently noted in brush or beneath heavy forest cover, such as spruce. Large numbers of these beds are present in areas where elk are plentiful, showing that these resting places are often exchanged for new ones. In forested country where sword ferns are abundant the number of eaten and uprooted fern plants is greater near these beds than elsewhere, indicating that resting places often may be situated close to feeding grounds. These beds are seldom located more than a few feet off the trails and always have a well defined path leading to them. They were noted on the tops of ridges, on the sides of canyons, and in the bottoms of ravines. Apparently the only factor that might possibly influence their location is the proximity of food.

In addition to these beds in the open brush and forest undergrowth, used by single individuals, there appear to be larger bedding grounds which residents who have observed these animals for many years claim are used by small herds of elk during the winter months. These places are in clearings, sometimes as much as 20 yards in diameter, situated along the coastal margins of the spruce forests, where the soil is trampled and devoid of vegetation. The heavy canopy of spruce boughs overhead, combined with the absence of underbrush, tend to render these sites relatively dry during the rainy season. Quite a few of these herd beds were seen, and numerous droppings were noted at these places.

Reproduction.—Because of the time of year at which this study was made, there was no opportunity for determining by direct observation the time of the rut, or when the young are born. Information contributed by seemingly reliable observers indicated, however, that the rut in this region begins in September, at which time the bulls have shed the velvet from their antlers, and continues for slightly more than one month.

Small deciduous trees, such as red alder (*Alnus rubra*) and cascara sagrada (*Rhamnus purshiana*), are most often used for rubbing the antlers. Many of these trees were seen stripped of their bark to a height of 7 feet above the ground. Presumably, the antlers are shed about March.

Natural Enemies.—Nothing is definitely known concerning the natural enemies of elk in northern California. It appears probable that the only animal that might attack them is the mountain lion (*Felis concolor*). Considering the size of an adult elk, it seems likely that the young would be more apt to suffer from this cause. As mountain lions are scarce in this region, however, they are not thought to be of importance in contributing toward elk depletion.

Disease and internal parasites undoubtedly play important rôles in this regard, but information pertaining to this subject is almost entirely lacking. It is known that three captive elk in the zoo at Sequoia Park, Eureka, California, died from an infection of lung flukes.

Present Status.—Judging by the number of animals seen, the reports of residents, and considering the natural ability of these animals to avoid observation in the dense cover which they inhabit, I have estimated that there were about 200 elk ranging over the area studied.

It is obvious that the Roosevelt elk is experiencing difficulty in maintaining its present numbers in what remains a partial wilderness in northern Humboldt and southern Del Norte counties. Within the limited territory in California which is now inhabited by this once extensively distributed species, lumbering and farming are continually increasing in importance each year. The removal of the coastal forests of tideland spruce means destruction of the principal cover upon which these animals are at present dependent. As most of this country is unsuitable for farming purposes this latter activity is limited largely to the valley of Prairie Creek. It is here, however, that elk are found during the spring and summer months when the small uncultivated clearings or so-called 'prairies' are covered with luxuriant grass. It is here also at this season that farmers come into conflict with elk, and in certain instances have definitely been known to shoot animals that have trespassed upon their property.

Within this restricted, elk-inhabited coastal strip, approximately 12 miles in length and 3 in width and comprising about 23,000 acres, about 6000 acres are state owned. This property composes what is known as Prairie Creek State Park, so-called because it includes much of the upper watershed of the creek from which it derives its name. In this area elk are assured of

permanent cover protection. During the winter months, however, as previously stated, few elk are to be found this far back from the coast. Consequently it seems likely that unless further action is taken to protect the remaining territory still inhabited by and suitable to the needs of Roosevelt elk in California, this species will follow the way of the plains wolf, grizzly bear, and bison, and cease to be represented in its native habitat within the confines of this State.

California Academy of Sciences, San Francisco, California.

THE SHOULDER MUSCULATURE OF THE PLATYRRHINE MONKEYS

By Berry Campbell

Preserved monkeys of the platyrrhine group are not easy to procure and it was the writer's great fortune to be able to assemble, through the courtesy of Dr. George W. Crile of the Cleveland Clinic Foundation, of the Hamann Museum of Western Reserve University, and of Dr. A. H. Schultz of Johns Hopkins University, a series including 1 *Oedipomidas geoffroyi*, 3 *Aotus zonalis*, 3 *Cebus capucinus*, 2 *Saimiri örstedii*, 2 *Lagothrix lagotricha*, 2 *Ateles dariensis*, 2 *Ateles geoffroyi*, and 1 *Alouatta palliata*. Unfortunately, no representative of the Pithecinae or of that interesting genus *Brachyteles* was available. This work was carried on while the writer was a Fellow in the Medical Sciences of the National Research Council.

The problem with which this paper deals is that of whether or not the prehensile-tailed monkeys, *Ateles*, *Lagothrix*, and *Alouatta*, and the semi-prehensile-tailed *Cebus*, share common adaptations of the shoulder musculature. Because of the fact that no monographic accounts of the myology of the platyrrhines are to be found in the literature, and that only scattered descriptions, mainly of *Cebus* and *Ateles*, exist, it was not considered necessary to give in this paper a complete review of the literature. There are included only such references as are pertinent to the matter under discussion.

THE EXTRINSIC SHOULDER MUSCLES

M. trapezius.—The extent of the occipital origin of this muscle was variable. In *Ateles* there was none, the cranial end of the muscle ending on the midline a short distance behind the inion. All of the other forms dissected showed an occipital origin—slight in *Lagothrix*, considerable in *Saimiri*, *Aotus*, and *Cebus*, and extending as far laterally as the mastoid region in *Alouatta*. In *Oedipomidas* there was a small separable portion arising from the mastoid region, but the origin of the main part extended only to the inion. Caudally, the origin reached Th. 8 in *Oedipomidas*, and Th. 9, 10, or 11 in the other forms.

There was a difference between the prehensile-tailed forms and the others in the extent to which the trapezius inserted on the clavicle. In the second group and in

Cebus the insertion extended only on to the acromial tip of that bone, whereas in the prehensile-tailed forms there was considerable clavicular insertion. This covered a fourth of the bone in *Ateles* and *Alouatta*, while in *Lagothrix* it attached to a third or a half of the acromial end.

M. omohyoideus.—No trace of this muscle could be found in *Aotus*, *Lagothrix*, *Ateles*, or *Alouatta*, although it was present and in no way unusual in *Oedipomidas*, *Saimiri*, and *Cebus*. In the 3 latter forms it arose from the superior margin of the scapula immediately posterior to the scapular notch. Insertion was on the hyoid.

M. latissimus dorsi.—This muscle presented few variations of interest here. The extent to which the origin reached cranially along the vertebral column was: *Oedipomidas*, Th. 4; *Saimiri*, Th. 5; *Aotus*, Th. 5 or 6; *Cebus*, Th. 7 or 8; *Ateles*, Th. 7, 8, or 9; *Lagothrix*, Th. 7; *Alouatta*, Th. 7. Anteriorly it extended to the following ribs: *Oedipomidas*, 8; *Saimiri*, 8; *Aotus*, 10, 11, or 12; *Cebus*, 8, 9, or 10; *Ateles*, 6 or 7; *Lagothrix*, 8; *Alouatta*, 7. In every animal insertion was on the lateral side of the bicipital groove of the humerus. There was no tendency for it to fuse with the insertion of the teres major.

In *Alouatta* there was a small bundle of fibers arising with the teres major near the inferior angle of the scapula and joining the latissimus on its posterior border. This is the only instance of scapular origin of this muscle observed.

In one of the specimens of *Ateles* the regular insertion was supplemented by small tendinous bands attaching to the joint capsule and the adjacent axillary margin of the scapula. These and the various fascias anchoring the dorso-epitrochlearis (see below) become understandable in the light of the theory propounded by Howell (1935) that the latissimus is inserted primitively upon the shoulder joint and not upon the humerus alone.

M. rhomboideus.—In all but *Alouatta* and one *Cebus* the rhomboideus capitis was present and separate. In these two exceptions, the capitis element, although represented, was fused with the rest of the muscle to form one continuous sheet arising from the mastoid region to the inion and caudally along the spinal column to Th. 5 in *Cebus* and to Th. 7 in *Alouatta*. In no instance was the rhomboideus cervicis very distinct from the rhomboideus thoracis. These combined muscles took origin from the midline between the middle of the ligamentum nuchae to Th. 5 in *Oedipomidas*, Th. 5 in *Saimiri*, Th. 4, 5, or 6 in *Aotus*, Th. 7 in *Cebus*, Th. 7 or 8 in *Ateles*, and Th. 7 in *Lagothrix*.

M. serratus anterior.—In all the animals the serratus was divided by the insertion of the long scalene into two divisions, one extending over the cervical region and, deep to the caudal end of the scalene, to the first and second ribs, the other division arising more ventrally from the second rib and extending caudally. In a few instances (1 *Ateles*, 1 *Lagothrix*, and the 3 *Aotus*) the part of the muscle arising from the atlas was separate from the rest and might well have been called the atlantoscapularis posterior. In *Oedipomidas* the whole muscle was composed of many separate slips, and in some of the other specimens showing poor muscular development the same tendency was noted.

M. atlantoscapularis anterior.—Of the series dissected, *Saimiri* and *Cebus* differed from the rest in that this muscle inserted deep to the trapezius instead of superficial to it. In *Ateles* there was a tendency for the muscle to be divided distally, with one insertion on the acromion and another on the posterior end of the clavicle. This was noted also by Schück (1913). Only a slight division occurred in *Alouatta* and none in *Lagothrix*. In these two forms, however, the insertion extended on to the acromial end of the clavicle. The muscle was single in all of the non-prehensile-tailed forms and was limited in its insertion to the acromion and the adjacent portion of the scapular spine.

M. pectoralis major.—No particular uniformity in distinctness of the pars capsularis was encountered. Although apparent in all to some extent, it was most evident in *Aotus*, *Alouatta*, and one *Saimiri*. A clavicular origin of the pectoralis ma-

jor was found only in *Lagothrix* and *Alouatta*. In the former genus it involved the anterior fourth of the clavicle, in *Alouatta* only the anterior sixth. In these two genera it was related to the pars sternalis rather than to the pars capsularis, as it lay deep and not superficial.

The axillary border of the great pectoral in all animals was found to be folded under so that fibers arising from the caudal end of the sternum inserted more proximally than some of the others. Thus the line of insertion of this muscle on the humerus was turned back medially to form a J or a U. This was mentioned by Beattie (1927), who observed it in *Hapale*. The tendency was slight in *Oedipomidas*. It was well marked in all of

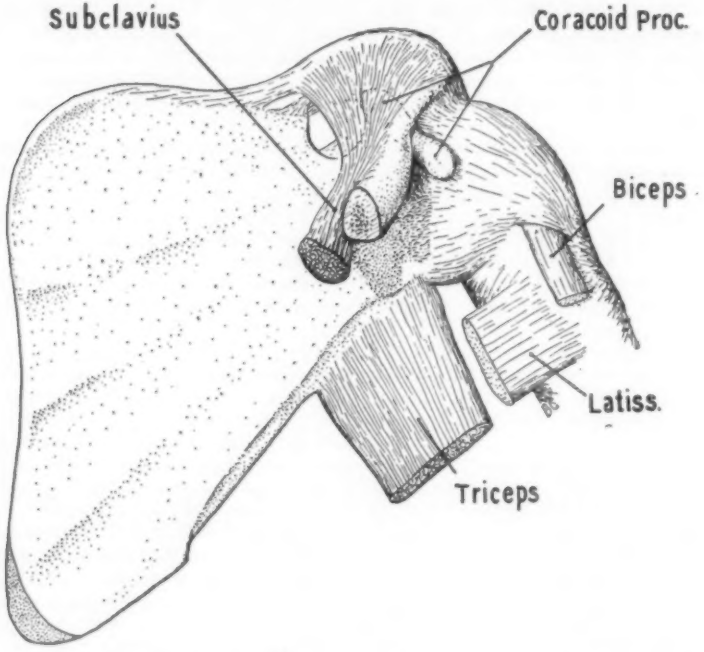


FIG. 1. Medial view of left shoulder of *Lagothrix lagotricha* to show the insertion of the subclavius muscle.

the other specimens, especially in *Alouatta*, where the entire pars sternalis was turned through an angle of 180 degrees.

M. pectoralis minor.—In all except *Ateles*, the lesser pectoral was separate from the pectoralis abdominalis. In that genus, however, there was a tendency for the two muscles to merge and in two specimens no separation could be discovered.

In the non-prehensile-tailed forms the rectus abdominis arose high on the thorax and crowded the origin of the pectoralis minor toward the midline. In all of these forms the origin of the pectoralis minor thus was from the sternum, from the level of the articulation of costal cartilage 2 down to the level of 4, 5, or 6. In some there was a small

origin from the fascia of the rectus. In the prehensile-tailed platyrrhines, the rectus did not extend as high on the thorax and the origin of the pectoralis minor was from the costal cartilages themselves, from cartilages 2, 3, and 4—and also, to a slight extent, from the fascia of the rectus.

In all the examples, the insertion was by means of a broad flat tendon, extending from a tubercle on the coracoid process, some distance from the tip, on to the joint capsule and, to a varying extent, on to the greater tuberosity of the humerus.

M. pectoralis abdominalis.—This was present in all animals. It was more or less fused with the pectoralis minor in *Ateles*. Insertion was in continuity proximally with that of the pectoralis minor and distally with the tendon of the panniculus carnosus when that muscle was present. In the absence of the latter muscle, the insertion of the abdominal pectoral was often continuous with that of the reflected axillary border of the pectoralis major.

M. panniculus carnosus.—This was found in all of the non-prehensile-tailed forms, including *Cebus*, and in none of the others. It was most highly developed in *Aotus*, where it consisted of dorsal and ventral parts which arose from the integument over the side of the thorax and converged to insert, by means of a long flat tendon, upon the greater tuberosity of the humerus in continuity with the pectoralis abdominalis. Some of the more ventral fibers were continuous caudally with an inguinal muscle derived from this element. The muscle was similar, although more poorly developed in *Oedipomidas* and *Saimiri*, and was very small in *Cebus*. In *Ateles*, *Lagothrix* and *Alouatta*, it was absent.

M. subclavius.—In the prehensile-tailed forms, the subclavius took origin from a tubercle on the first rib and inserted along the posterior surface of the clavicle, the posterior border of the trapezoid ligament, the posterior extremity of the coracoid process, and to the superior transverse scapular ligament. A part of the muscle occupied the same position as does the conoid ligament of man. In the other genera the subclavius inserted solely upon the clavicle. Nothing corresponding to the conoid ligament was evident. The trapezoid ligament, however, had an unusual development, for in addition to the ordinary clavicular attachment running transversely across the acromial end of that bone, there was a fan-shaped extension attaching laterally (and not medially as does the conoid ligament in man) to the insertion of the subclavius. In *Aotus*, where this reached its highest development, it extended for half the length of the clavicle.

THE INTRINSIC SHOULDER MUSCLES

M. supraspinatus.—There was a distinctly wider supraspinous fossa (as was noted by Frey, 1923, and Schultz, 1930) in *Ateles*, *Lagothrix*, and *Alouatta*, and consequently a larger muscular origin, than in the other genera. Aside from this, no significant differences were seen in the series dissected.

M. infraspinatus.—This detail presented no unusual features.

M. subscapularis.—In all forms, the caudal border of this muscle, the so-called pars axillaris, was heavily developed. This may well be correlated with the constant presence of an axillary sulcus on the scapula. The whole muscle was relatively larger in the three genera mentioned above because of the increased area of the subscapular fossa observed in those forms.

M. teres major.—Though variable in the extent of its origin from the fascia of the infraspinatus and in the width of its insertion, no correlation could be made between the attachments of this muscle and either functional or phylogenetic relationships. It usually was bound to the latissimus dorsi by fascia well back from the insertion, but upon the tendinous portion of the muscle no connections existed.

M. deltoideus.—In all specimens there were spinal, acromial, and clavicular origins of

the deltoid. The attachment to the clavicle usually extended over the lateral half of that bone. Very often there was also a broad origin from the fascia of the infraspinatus along a line between the tuber of the spine and the inferior angle, but owing to great variability within the genera, no significance can be attached to this.

M. teres minor.—No significant differences in this muscle were evident, although in *Ateles*, *Alouatta*, and *Lagothrix* it tended to have a more extensive origin.

M. biceps brachii.—Except in one example of *Ateles dariensis*, which presented a muscle exhibiting both a long head with a very small tendon and an additional humeral origin immediately distal to and confluent with the insertion of the deltoid, this muscle exhibited no variations. A similar variation was found in an *Aotus zonalis* by Howell and Straus (1931).

M. coracobrachialis.—Both the deep and the middle portions were constantly present. In no specimen was the coracobrachialis superficialis (longus) encountered.

M. dorso-epitrochlearis.—In addition to the constant fleshy origin of this muscle from the latissimus dorsi, there was, in all of the animals, an anchoring of the origin by means of a band of aponeurotic fibers that passed through the substance of the latissimus and emerged on the postero-medial surface to attach to the subscapular fascia, or, in the cases of *Alouatta* and *Ateles*, directly to the axillary margin of the scapula. Similar purpose was served by the fascial connection, found in all of the forms, between this part of the latissimus and the adjacent teres major.

M. triceps brachii.—In addition to the attachment to the glenoid half of the axillary border of the scapula, all of the animals exhibited an origin from the scapular spine through a tract in the infraspinous fascia.

DISCUSSION

It will be seen that in many particulars the animals studied are divisible into two groups. The first group contains *Oedipomidas*, *Aotus*, and *Saimiri*. The second includes *Alouatta*, *Ateles*, and *Lagothrix*. *Cebus*, it is interesting to note, stands intermediate in a number of cases. The more clear-cut muscular arrangements of the prehensile-tailed, which distinguish them from the non-prehensile-tailed, forms may be listed as follows: 1. The trapezius has a clavicular insertion. 2. The omohyoid is absent. The absence of this muscle was noted also in *Aotus*. 3. The atlantoscapularis anterior has a clavicular insertion. 4. The pectoralis minor arises from the costal cartilages. 5. The panniculus carnosus is absent. 6. The subclavius has a scapular insertion. 7. The supraspinatus is relatively larger. 8. The subscapularis is relatively larger.

Added to these are the two following variations which, because they do not occur in all of the prehensile-tailed forms, may be of less significance: 1. The pectoralis major has a clavicular origin in *Alouatta* and *Lagothrix*. 2. The dorso-epitrochlearis is anchored to the axillary margin of the scapula in *Ateles* and *Alouatta*.

The prehensile-tailed platyrrhines do not all use their forelimbs in a similar manner. *Ateles* and *Lagothrix* frequently brachiate. *Alouatta*, on the other hand, does not use this type of locomotion. Instead, it seems to have relatively unspecialized forelimb action patterns. Thus, in order to maintain that the myological similarities between *Alouatta* and the Atelinae were functional in origin would make necessary the hypothesis that the howler had at some previous geological time passed through a brachiating stage. Less clumsy is the explanation that these similarities reflect close genetic relationship. This conclusion was reached by Pocock (1925) in a study of the external characters of the New World monkeys. He suggested that possibly the hyoid and cranial differences upon which the isolation of the howler from the Atelinae was predicated may be adaptations to the vocalizing habit and not trustworthy phylogenetic evidence. The material

presented in this paper substantiates his theory. Because of the close similarity in the prehensibility of the tail, of the external form and details, and of the structure of the shoulder, and in spite of the cranial and laryngeal specializations, it is here proposed to drop the subfamily Alouattinae and include its contents in the subfamily Atelinae.

LITERATURE CITED

Beattie, J. 1927. The anatomy of the common marmoset (*Hapale jacchus* Kuhl). Proc. Zool. Soc. London, pp. 593–718.

Frey, H. 1923. Untersuchungen über die Scapula, speciell über ihre äussere Form und deren Abhängigkeit von der Funktion. Zeitschr. f. Anat. u. Entwickl., vol. 74, pp. 240–284.

Howell, A. B. 1935. Morphogenesis of the shoulder architecture. Part III. Amphibia. Quart. Rev. Biol., vol. 10, pp. 397–431.

——— and W. L. Straus, Jr. 1931. The brachial flexor muscles in primates. Proc. U. S. Nat. Mus., vol. 80, pp. 1–31.

Pocock, R. I. 1925. Additional notes on the external characters of some platyrrhine monkeys. Proc. Zool. Soc. London, pp. 27–47.

Schück, A. 1913. Beiträge zur Myologie der Primaten II. 1. Die Gruppe: Sterno-cleido-mastoideus, Trapezius, Omo-cervicalis. 2. Die Gruppe: Levator scapulae, Rhomboides, Serratus anticus. Morph. Jahrb., vol. 47, pp. 355–418.

Schultz, A. H. 1930. The skeleton of the trunk and limbs of higher primates. Human Biol., vol. 2, pp. 303–438.

Laboratory of Anatomy, Western Reserve University Medical School, Cleveland, Ohio.

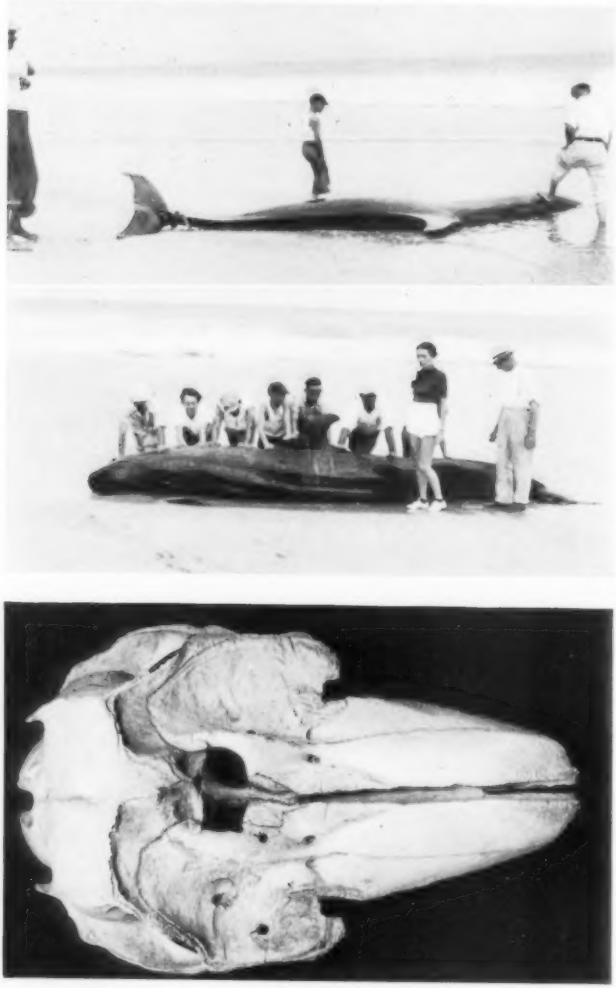
THE FALSE KILLER WHALE ON THE NORTH CAROLINA COAST

By H. H. Brimley

On July 5, 1935, while a small party was on its way by automobile from the hotel at Hatteras village to the inlet of the same name to fish the surf for channel bass, a large, dark object was seen in a slough on the ocean side of the beach about one-half mile east of the inlet and close inshore. Upon investigation this object proved to be a small whale of some kind, apparently injured. A member of the party, Mr. E. B. Kugler, of Raleigh, who usually carries in his salt-water tackle box a pistol for use on sharks, opened fire on the animal as the forepart of its body rose above the surface. Following one of the shots, the creature spouted blood and soon thereafter seemed to have expired. Other fishermen soon gathered around, a truck and block and tackle were brought from the hotel, but the combined personnel and equipment were unable to move the carcass above high-water mark.

Several teeth were knocked out and saved, mostly in fragmentary form, and a number of photographs were taken of the animal. The pictures showing a profile view of the head seemed to point to *Pseudorca*, and this tentative identification was later confirmed by Gerrit S. Miller, Jr. of the U. S. National Museum, after an examination of the fragments of three of the teeth.

Those who saw it on the beach assumed the animal to be a blackfish (*Globicephala*), as this is the best-known of the larger Delphinidae found along



Pseudorca crassidens. Upper and middle views, on the beach at Hatteras Inlet. Photos by E. B. Kugler. Lower detail, dorsal view of skull.

the Atlantic Coast of the United States, and no effort was made to save the skull or any part of the skeleton. The next flood tide carried the body out to

sea, and thus seemed to vanish the only likely opportunity to secure a local specimen of *Pseudorca* for the North Carolina State Museum. Several months later, however, I learned that the carcass again had been washed ashore nearby, and this time the waves had carried it so far up the beach that it had remained there.

Following considerable correspondence with various individuals, the Museum finally secured the skull, except for the lower mandibles and the teeth; also, 5 ribs and 32 vertebrae, including the 7 fused cervicals, which reached us on April 17, 1936. No teeth were found associated with the bones. The skull proves to be that of *Pseudorca crassidens*.

The total length of the specimen, as stepped off on the sandy beach, was reported as 20 feet; but judging by the height of the woman in the picture, Mrs. E. B. Kugler, as ascertained from her husband, 18 feet is nearer the true length. The skull of this specimen measures 666 mm. in length by 398 in width. With teeth and lower jaw missing, it weighs 18.5 pounds. There are eight tooth-sockets on each side.

So far as I have been able to ascertain, this is the first record of *Pseudorca* found alive and secured on any part of the coastline of the United States. The only other United States records of this animal are the parts of the skeletons of four individuals found on the shore of Biscayne Bay, Florida, in 1918, and a single specimen stranded in the neighborhood of Hillsboro Lighthouse, near Deerfield, Florida, previous to May 5, 1922.

Although the osteology of *Pseudorca* is fairly well known, there seems to have been but little published regarding its habits, except that it frequently gathers in large schools, and that it feeds largely on cuttle fish. It seems, also, to have the habit of becoming stranded, often in numbers, on many widely-separated coasts, it being almost world-wide in its distribution. Points in the North Sea, and the Chatham Islands, New Zealand, appear to be about the northern and southern limits of its range. The few Pacific records are confined to the eastern side, namely, La Paz, Lower California; Acapulco, Mexico; and Paita, Peru.

State Museum, Raleigh, North Carolina.

EL VALLE DE LA TRINIDAD, THE COYOTE POISONER'S PROVING GROUND

By Laurence M. Huey

There has been considerable controversy on the subject of coyotes during the past few years. Strong political pressure for their extermination has been brought to bear and large governmental sums of money have been expended for poison campaigns, which, without doubt, have brought hardships on mammalian life other than the coyotes against which the poison was directed. All this has been done without completely determining just the niche in Nature's program occupied by the coyote.

It is admitted that coyotes occasionally do prey on young domestic stock and poultry, and in such cases the individual predators must be controlled. This fact, however, does not warrant the extermination in any locality of coyotes, or of any other beast or bird that man dubs predatory because he has cast temptation in its path. Caution should be the watchword, lest the reaction from the destruction of the supposed offender be of more serious moment than was the offender originally. Such seems to have been the case in the region about which I now write.

During the summer of 1926, I collected birds and mammals in El Valle de la Trinidad, Lower California, Mexico. This narrow, semi-desert valley is about 80 miles south of the International Boundary and separates the southern end of Sierra Juarez from the northern end of Sierra San Pedro Martir. It is about 22 miles in length and is entirely on the Pacific slope. Rather high, partially wooded hills bound this valley on three sides, making it ideal for cattle raising. In this capacity the region had been used for many decades.

At the time of my visit in 1926, mammal life was normally abundant. *Dipodomys*, *Peromyscus*, *Citellus*, *Onychomys*, *Lepus*, *Sylvilagus*, and *Ammospermophilus* were finding subsistence amid a good growth of mesquite brush, cacti, and annuals growing on the valley floor. A balanced population of coyotes and a goodly number of kit or desert foxes were present, and the stockmen who owned the valley grazed as many cattle as the feed would support. It was at this time that coyote poisoning campaigns were being pushed in our western states, so a few of the stockmen of northern Lower California decided that if the wealthy stock raisers of the United States deemed the coyote a menace, surely they too must stand to lose with the large coyote population they knew existed on their ranges. They therefore commenced placing poison baits about every cow that died.

At the time of the campaign's inception a visit could hardly be made into the northern backbone of the peninsula without seeing one or more California condors, and coyotes could be heard every night, although an observer would have no way of computing their numbers. In conversation with the cattle-

men at that time, I found that they had but little concrete evidence against the coyote, their ideas all being based on assumption. Naturally, their supposed losses were great. Thus did the writer leave El Valle de la Trinidad in 1926.

Ten years later, in March, 1936, I returned, this time also for kangaroo rats, nor was I disappointed. Kangaroo rats fairly swarmed; they were everywhere. The first night 100 traps were set and next morning 66 *Dipodomys* were taken from them, in addition to 6 that had been run down and caught during the previous evening, with the aid of a lantern. Seventy-two kangaroo rats for one night's trapping! It seemed out of all proportion; something must be amiss. Yet during the 13 nights following, over 600 kangaroo rats were taken without moving the traps! During this period, coyotes were heard wailing, but not in the usual numbers to be expected in Lower California. The same cattlemen still ran this ranch and in conversation with the managing rider (who incidentally is an American), it was found that they were still poisoning the cattle carcasses whenever possible. He admitted that the coyote population had been reduced. There were two problems that puzzled him, however. An area about 2 miles long in the center of the valley that formerly had had a cover of alfilerea and other low annual herbage had been denuded, and the strong winds had thrown up great sand dunes—"blow sand," he called it. The other problem was that great areas of the valley floor were becoming rapidly overgrown with lush green dock, a weed that livestock will not eat. All this, he said, had happened within the past 4 or 5 years. It seemed incomprehensible to the ranchmen, as they were not running as many cattle on the range as they had 20 years earlier; yet the feed was failing rapidly. Each year there was more dock, more bare sandy areas and less feed. What could be the cause?

After a week of such prodigious catches of kangaroo rats, the explanation for these conditions was apparent. Upon further questioning the cowboy, it was found that the kit foxes had almost disappeared in the valley, and during the 23 days that I spent in the vicinity no condors were seen. Evidently the poison was getting in its work, slowly but surely.

Kangaroo rats, with most of their natural enemies removed, breed rapidly and, being entirely graminivorous, it was doubtless they that were taking most of the feed. These mammals start to forage when the first blades of grass appear and, as a result, the grasses stool out into stunted, prostrate plants that are too short for cattle fodder. With a greater rodent population not only is the grass destroyed, but the seed as well, preventing reproduction. Bare spaces appeared on the soft sandy soil and the wind commenced to cut and pile up the sand into dunes.

The question of the dock, when studied, also was not difficult. This plant is a prolific producer of seeds and propagates readily in sandy soil, although it is easily choked out in its early stages by rapid-growing annuals. With

the removal of the annuals it had had full sway. Neither stock nor rodents will eat of its foliage, although kangaroo rats will accept the dried seeds when more favored food is not to be had. This is advantageous for the dock, since the rats are great seed gatherers and, after filling their nests, they proceed to carry the seeds from place to place, burying them as caches in small shallow holes, thus placing the seeds at just the right depth for germination.

Nature's gardens are planted that way, but the gardeners usually are not so numerous. Thus the dock was spread, but not fast enough to control the soil erosion. Indeed El Valle de la Trinidad seemed to be a proving ground for man's disturbance of Nature's balance. But what of the future? Given time and no further interruption other than the presence of the livestock, Nature would adjust herself. The coyotes would regain their former numbers and cut down the abundance of small rodents which, after all, are their natural food. But the probabilities are not favorable, for, with the visit of the mammalogists, the ranchers learned that small rodents were swarming, and their thoughts again turned towards poison—this time poisoned grain!

With the history of 10 years' meddling so plainly demonstrated by the scars on the valley floor, one might care to speculate on the decade to follow. Just what and where will be the end? There is no doubt but that Nature will always keep trying to readjust herself, although man is in reality the arch-predator and is forever blindly putting into play the most fantastic schemes.

If, for instance, a poison campaign be carried out on the kangaroo rats, what will happen? Cattle raising is the only human pursuit in El Valle de la Trinidad. A few very small fields are the only agricultural efforts, so after the kangaroo rats have been poisoned off the dock will have not a living friend or enemy to assist or check its increase. The wind will take over the spreading job, perhaps with even greater vigor than the seed-gathering rats. As a result the last vestige of suitable range fodder may pass, and El Valle de la Trinidad be left a barren waste of cacti and mesquite, verily a coyote poisoner's proving ground.

San Diego Society of Natural History, Balboa Park, San Diego, California.

NOTES ON WINTER FOODS OF MICHIGAN DEER

By William Johnston Howard

During the winter of 1934–1935 the writer was assigned as wildlife technician to the National Park Service CCC Camp at Wilderness State Park, Emmet County, Michigan. Part of his duties was to make observations of the winter food of the deer (*Odocoileus virginianus borealis*).

Wilderness State Park is situated at the extreme northwestern tip of the lower peninsula of Michigan. It is bounded on the north by the Straits of Mackinac, and on the west by Lake Michigan. Adjoining it on the east and south are private lands of similar topography and vegetation. The park contains approximately 7000 acres. The area is densely wooded with second growth, except for a few small open hay marshes, and the western portion of the park, which is in sedge meadow with a few small clumps of trees. About two-thirds of the park is low-lying and is covered with extensive white cedar (*Thuja occidentalis*) swamps. The higher parts are covered, in general, with mixed second growth forest. Poplar (*Populus tremuloides*) and white birch (*Betula alba* var. *papyrifera*) predominate on these parts. The last large fire occurred about 75 years ago, although there have been lesser fires within the past 20 years. As a result of the dense forest growth, shrubby vegetation is scant.

The park has been protected from hunting since 1921 and no wildlife management, with the exception of sporadic attempts at predator control, has been attempted by the Michigan Department of Conservation. The chief deer predators are coyotes (*Canis latrans*) and bobcats (*Lynx rufus*). The effect of predators upon the deer herd in Michigan is extremely controversial, and recently, due to public pressure, a bounty law has been enacted. At the present time the Game Division of the Department of Conservation is making an honest effort to solve the predator problem and has assigned a mammalogist to its study.

In the park the deer herd has been protected from hunting and allowed to multiply unchecked until at the present time the land is probably carrying an over-population. Various estimates of the deer population state the number to be about 15 to the square mile. The estimates, by game officials, have been made as guesses and as a result of a deer drive by CCC men.

The winter food supply of the deer in the park seems to be approaching a critical stage. The principal food, white cedar, exhibits a severe browse line, and few if any young trees are coming in. As the forest grows older the inevitable result will be a decrease in the number of deer, unless fires or cuttings occur to open new areas and create more favorable food conditions.

The following list is not intended to be a complete enumeration, but the writer wishes to record the plants that appear to comprise the principal winter foods, and to record some interesting facts concerning the relation of deer

to their winter food supply. The following remarks relate to foods in Wilderness State Park, unless otherwise specified.

White cedar (*Thuja occidentalis*) is the principal winter food and is utilized to the extent that a distinct browse line is present. Little, if any, reproduction is taking place. When the snow begins to deepen in early winter the deer move into the cedar swamps, and there is no general movement therefrom until the snow begins to disappear in the spring. Wherever piles of cedar branches occur as a result of trail clearing or post cutting, they always are found by the deer and completely stripped of foliage, often in a single night. In one instance a snow fence made of cedar was completely denuded of foliage within a few days.

Only in the western part of the park did the cedars show no browse line until the winter of 1935–1936. It was thought that possibly the open character of this cold, windy part of the park might explain why it was the last portion to be heavily browsed.

At the Pigeon River Tract, Vanderbilt, Michigan, all white cedar trees planted for landscaping and stream bank protection in the winter of 1935–1936 were so severely browsed that the plantings were a total failure.

Although white cedar seemed to be readily consumed over most of the area at Wilderness, when branches of it were used as bait in traps to capture deer for ear marking it did not prove successful, and it had to be replaced by alfalfa.

A compensating factor for supplying deer food immediately after excessively wet and heavy snows was noted at Wilderness. At such times it is difficult for the deer to move over very much territory, and the heavy snows that made travel difficult burdened the small white cedar trees and bent them to the ground, so that an emergency food supply thus was made available.

Common juniper (*Juniperus communis* var. *depressa*) is not abundant in the park, as it is confined to about 200 acres of a sandy area along the Straits shore. It is heavily browsed, especially when in the scale form, and many fine large specimens are dead, possibly as a result of overbrowsing. No reproduction is taking place.

Horizontal juniper (*Juniperus horizontalis*) grows over a much more extensive area, as it is found along most of the sandy banks of the Straits. While it may furnish more food for a short period, because of its manner of growth it is available only until the coming of deep snows. During the pinch periods in late winter it is buried so deeply that it is unavailable.

The latter statement also might be made in the case of bearberry (*Arctostaphylos uva-ursi*). It also occurs along the sandy banks of the Straits and is heavily browsed until the snow deepens. It is commoner than the junipers, seems to stand browsing better, and appears to be in no danger of extermination within the park.

Red-osier dogwood (*Cornus stolonifera*) seems to be a favorite food plant. It is common in the park on the edges of small swamps and openings, and

wherever observed it was heavily browsed. While the plant has considerable value for wildlife, as berries for birds and forage for deer, it was browsed so extensively that landscape and food plantings were a failure, as it was consumed by deer before it had a fair chance to become established.

Labrador tea (*Ledum groenlandicum*) is common in marshes and damp thickets. Although several instances were noted where a deer had nipped off a few twigs as it walked along a trail, there was no evidence that the plant was more than casually utilized.

Quaking aspen (*Populus tremuloides*), poplar, or popple as it is known in the north country, is the winter mainstay of the beaver. When trees are felled so late in the fall that a freeze occurs before the food can be cached by the beaver, the deer feed upon the upper branches. Any branches that fall to the ground in winter are usually barked the first night by snowshoe hares (*Lepus americanus*), when the latter are abundant. Where branches of this tree were piled by labor crews they served as browse for deer. Old dead, down limbs were noticed with fresh signs of browsing by deer.

Although white birch (*Betula papyrifera*) is common in the more recent burns, it is utilized rather sparingly. Several instances were noted where it had been eaten from fresh brush piles and from small standing trees.

On a gravel ridge near the CCC Camp were a few stocks of mullein (*Verbascum thapsus*). These were not touched until after the first light snow, but then they were defoliated in a few nights. The leaves were consumed, and some of the stalks were chewed.

Silver maple (*Acer saccharinum*) and red oak (*Quercus borealis maxima*) were noted as being moderately browsed. Neither of these trees are numerous in the park. Bartlett and Stephenson (Michigan Acad. Sci. Arts Letters, 1928; 1929) indicate that in the Upper Peninsula hardwood deer yards, deer browse to some extent on all the hardwoods, and that maples are preferred. Possibly at Wilderness Park white cedar is yet too much a competitor for the available hardwoods.

Service berry (*Amelanchier canadensis*) is common as a shrub and small tree, and is moderately browsed.

Balsam (*Abies balsamea*) is abundant in the park, and, curiously enough, shows moderate browsing. No browse line is evident, however. It is not generally considered to be good deer food and Bartlett (Michigan Acad. Sci. Arts Letters, 1931) has said of it: "If deer cannot obtain enough of their preferred foods they will browse on balsam and sometimes on spruce, but if forced to do this for long, many of the herd seem to sicken and die."

Hemlock (*Tsuga canadensis*) is scarce, being confined to a small stand of mature trees. No evidence of reproduction was noted. Whenever a branch fell or was cut by an arboreal animal, the deer speedily consumed the foliage.

Ground hemlock (*Taxus canadensis*) was not listed at Wilderness, but it seems to be a favorite food near Petoskey.

Viburnum cassinoides is common at Hartwick Pines State Park, Grayling,

Michigan, and is heavily browsed. It was not identified at Wilderness State Park.

Sumac (*Rhus* sp.) was used for landscape plantings at Hartwick Pines and was heavily browsed, almost to the ground. It does not occur at Wilderness, and its absence might, in part, be explained by the heavy deer population.

The following plants were noted as being lightly browsed. In none did there seem more than casual feeding: white spruce *Picea glauca*, white pine *Pinus strobus*, balm of Gilead *Populus balsamifera*, tamarack *Larix laricina*, honeysuckle *Lonicera canadensis*, buffalo berry *Shepherdia canadensis*, wild rose *Rosa humilis*, sweet gale *Myrica gale*, spirea *Spiraea latifolia*, sand cherry *Prunus pumila*, shrubby cinquifoil *Potentilla fruticosa*, alder *Alnus incana*, poplar *Populus grandidentata*, flowering raspberry *Rubus odoratus*, red raspberry *Rubus strigosus*.

It is interesting that *Populus tremuloides* is moderately browsed, while the other two poplars in the above list are but lightly browsed.

National Park Service, Richmond, Virginia.

EVENING BAT FLIGHT FROM CARLSBAD CAVERNS

By Vernon C. Allison

The evening flight of bats from Carlsbad Caverns, New Mexico, on their way to procure their food in the valley of the nearby Pecos River, is an interesting sight. In fact, it was the curiosity inspired by this somewhat spectacular phenomenon that led to the discovery of this system of caverns. Now that all entrances except the main one have been closed, the eruption of bats at the close of day resembles smoke pouring from a volcano.

The Carlsbad Cavern bats, *Tadarida mexicana mexicana*, have been well described by Bailey (Animal Life of the Carlsbad Caverns, 1928) who directed attention to the fact that their roosting place under the highest dome of the cave ceiling is so inaccessible to ladders, or even searchlights, that any estimate of their numbers must be based on their flights to and from the cave. Indirect evidence of their great number is afforded by the large deposits of guano that have been removed from the caverns in the past. The number of bats appears to vary somewhat with the seasons, and in the late summer and early fall they pour from the cave opening in such a dense black stream that they can be seen from a distance of 2 miles. They fill the shaft so closely that they can be caught in the hands as they pass out, while the noise of their beating wings and of the striking together of their overlapping wing tips are plainly apparent at quite a distance from the cavern opening.

On the way into the caverns, one passes the entrance to the bat cave, where visitors are not taken, and here there is a placard with the announcement that the number of bats in the cave has been estimated by the U. S.

Biological Survey as 3,000,000. This estimate was made by Bailey (in private communication) who counted as nearly as possible the number of bats in a cubic yard of air during the flight, and estimated the number of cubic yards of bat-occupied air in the flight column and the duration of the flight as closely as circumstances permitted. Then, realizing the lack of precision of the improvised method, a "factor of safety" was applied, and the estimated number of bats thus reduced to 3,000,000. Not knowing of this estimate, and before seeing the placard in the caverns, I applied a similar but somewhat more precise dynamic method for estimating the number of bats, and the following results were obtained.

On the evening of June 16, 1936, I attempted a conservative estimate of the number of bats that left the cavern entrance. The flight began very suddenly at 7:03 P.M., continued in full force until 7:17 P.M., a period of 14 minutes, and then tapered off until at 7:21 P.M. there were no bats leaving the caverns.

The column of bats flying from the caverns was approximately cylindrical in cross-section and at least 20 feet in diameter. The noise and air currents set up by the flight were plainly perceptible from the point of observation about 75 feet from the opening. Frequently a few bats retraced their flight to the cavern entrance, and periodically the column seemed to break up into sections a couple of hundred yards in length. Each of these sections then proceeded on a slightly different course, all flying in a general southerly direction toward the Pecos River Valley. Near the end of the flight there were half a dozen of these sections in view, some near and some far. The bats are said to return to the cave in the morning in a formation even more compact than that in which they leave in the evening.

The signal for the sudden evening flight probably is supplied by a slight interference in the thermal air circulation, the "chimney draft" effect common to all underground chambers directly connected with the atmosphere. As the flight occurs so near sundown, the interference probably is due to the chilling of the outside air as the sun sinks below the horizon. This flight on June 16 started a few minutes before sundown when there were a few scattering clouds in the west; but the flight probably never occurs after the time of true sundown. Such a thermal disturbance may be only slight in degree, but quite critical nevertheless.

It was estimated that the speed of flight of the bats was about 20 miles per hour, which is, roughly, 29 feet per second. An approximately cylindrical column of 20 feet in diameter has a cross-section of 314.16 square feet. It was estimated that each cubic foot of space in the column was occupied by 1 bat, so each linear foot of the column contained 314 bats; hence 29 linear feet of the column, or 9106 bats, passed the observation point each second.

The full force of the flight continued from 7:03 to 7:17 P.M., a period of 14 minutes, or 840 seconds. During this time there thus were 840 times 9106, or 7,649,040 bats leaving the cavern. The odd figures are carried merely to

illustrate the method of estimation and are all discarded at the completion of the estimate. During the period from 7:17 to 7:21 P.M., the bats left the cavern at a rate of about one-half the maximum, or 4553 per second, or 1,092,720 during these four minutes. The total number of bats that left the cavern on the evening of June 16, therefore, was 8,741,760. This estimate of slightly under 9,000,000 bats is believed to be nearer the actual number in the caverns in early summer than is the previous estimate of 3,000,000.

Bailey (personal communication) accepts this higher estimate as more nearly correct than his previous one, and he has suggested that it stand until the bats can actually be counted. He mentions the use of photography, both still and moving. This suggestion appears to be sound and it is further suggested that motion pictures be taken of the entire flight through a charted foreground. The latter could be close to the flying column and the camera, equipped with a telephoto lens, located at a distance from the column, to minimize angular complications. Then sample still-cuts could be made and the bats in the "frozen" section of the flight column actually counted. From these various sampling still-cuts the number of bats flying from the cavern could be very closely approximated.

Picatinny Arsenal, Dover, New Jersey.

NOTES ON SOME MAMMALS OF WESTERN MASSACHUSETTS

By H. E. Warfel

Since the publication of Crane's work (1931) on the mammals of Hampshire County, Massachusetts, there have come to light several items of interest in the western part of that state. Crane's paper presented a very accurate picture of a typical county in that region, and these notes augment that work, with data from both Hampshire County and the surrounding territory.

Squirrels (*Sciurus carolinensis leucotis* and *Sciurus hudsonicus loquax*).—During the years 1934 and 1935, gray squirrels were very abundant in this region. They moved about the country quite freely and at one time were reported in migration. Numbers were killed on the highways by motor cars, and squirrel hunting was good. This condition obtained in 1935 to a lesser extent. In the fall of the latter year a game warden in Franklin County reported 22 drowned at a falls in the Deerfield River. At present (September, 1936), while they are by no means extinct, they are less abundant than formerly.

Red squirrels, which generally have been common, likewise increased in numbers during the years 1934 and 1935.

Hares and **Rabbits** (*Lepus americanus virginianus* and *Sylvilagus transitionalis*).—Hares and rabbits are very scarce in western Massachusetts at present, and from reports of hunters and observations there seem to be large areas where they do not exist at all. Censuses were taken in three forests in Berkshire County and in approximately 1500 acres surveyed for game refuge purposes, there were very few individuals of either species. In parts of this territory they are being released for hunting purposes.

This shortage is difficult to understand. Several reasons are popularly quoted, among them being the great prevalence of predatory species (foxes and skunks) that resulted from the anti-steel-trap law, in operation since 1930; disease; and the fact that the country is not developed in a manner which would permit a large rabbit population.

Jumping Mouse (*Zapus hudsonius hudsonius*).—Crane listed this species as rare and cited one record. A specimen in the Massachusetts State College Museum was collected near Amherst in 1896. In the late summer of 1935 I was present when the superintendent of the Sunderland fish hatchery, located at the eastern edge of the Connecticut River Valley, skimmed from the rearing pools several jumping mice that had been drowned during the night. He said that although he had never known this to happen in previous years, the occurrence had been rather common that summer. A few more were caught in this way in 1936 and the superintendent of the Mt. Toby Forest reported finding them frequently in his cord wood lots.

Beaver (*Castor canadensis canadensis*).—In 1931 a beaver colony was discovered in the town of Stockbridge, southwestern Berkshire County. This is the first beaver record for the state in many years. Allen (1869) said that "The beaver is to be reckoned among those few animals that, in this state, have become fully exterminated." A planted colony exists on a private refuge in Lenox, Berkshire County.

Bear (*Euarctos americanus americanus*).—For the past 3 years, there have been frequent indications of bears on Mt. Toby Demonstration Forest in Franklin County. Members of the forestry staff at Massachusetts State College have seen tracks and other indications during that time. Professor W. H. Davis of the same college encountered a bear while hunting in that area in 1925. On August 15, 1936, a Mr. Squires, who lives on property adjoining the forest, reported seeing a bear on a road that runs along the northern edge of the forest. On August 18, Superintendent McCleary, of the forest, saw unmistakable bear tracks coming from the edge of Cranberry Pond, which lies in the northeast corner of the Mt. Toby tract. Reports about bears in the Berkshire Hills are periodically circulated, and Gordon (1908) reported one killed in the town of Williamsburg, Hampshire County, in 1907. Hatt (1930) reported occasional stragglers in the Harvard Forest, which lies in the north central part of the State.

Bears probably have always been present in this territory. Allen has said that they were seldom seen in the middle of the last century, but it is logical to conclude that if they were present then they have always existed in the area.

Otter (*Lutra canadensis canadensis*).—Otters have always been present in western Massachusetts, probably in greater numbers than the trapping and sight records indicate. The earlier writers always mentioned them as being present, and Gordon (1908) cited 10 records from the Connecticut River and adjacent regions. I have seen an otter den on Ward's Pond in the town of West Otis, in southern Berkshire County. Russell Smith, an expert hunter and trapper, has seen them on Mud Pond in the same town, and on the Tunxis Club property in Tolland. Three other localities have been mentioned to me but have not been verified. At present there is a den of two adults and two young on Cranberry Pond in the Mt. Toby Demonstration Forest. Hatt (1930) reported them in the Harvard Forest. No doubt others occur.

Moose (*Alces americana americana*).—Rumors concerning the presence of moose in the western part of this state have been so persistent during the past several years that it was deemed advisable to investigate the validity of these reports. These animals have been seen and killed within the past 10 years in Berkshire County, and in the past 5 years have been tracked and seen in Franklin County.

Ray Blivens, a woodsman well acquainted with that section, reported that he knew of a moose killed in the town of East Otis, in southern Berkshire County, in the winter of 1925–1926. This man also reported seeing a female with one young in that same locality at about the same time. A moose was killed on top of Jacob's Ladder in the winter of 1931–32, according to a Mr. Tacy, who was working as a mail man in that region. Crane

(1931) also mentioned one killed in this county in 1929–1930. Russell Smith stated that almost every deer season brings reports of moose having been seen in the southern part of this territory.

Warden Hughes, in Franklin County, informed me that he has received several reports of moose in his district during the past 5 years. Near Mt. Toby Forest, in the spring of 1934, Tom McCleary saw a moose, probably a female, that he accurately described, and the next morning the superintendent of the forest and Professor R. B. Holdsworth, of the Forestry Department of Massachusetts State College, measured the tracks, which they found to be 5.25 inches long and 3.5 inches broad. These tracks were in plowed ground and the marks of dew claws were visible. Superintendent McCleary also has seen similar tracks in the forest well toward the top of Mt. Toby. In October, 1934, Professor Davis came across what he and his companion considered to be moose tracks in the town of Heath, which lies in the center of this county.

In the winter of 1931, on Mt. Lincoln in the Pelham Hills, Hampshire County, Herman Goodell, assistant librarian at Massachusetts State College and an experienced nature student, saw and sketched large tracks that measured 5.25 by 3.25 inches and were about 8 feet apart. These tracks were in soft, shallow snow, and he followed them for one-half mile. The dew claw marks were visible in places. The sketch conformed with the tracks pictured by Seton, and since this locality is about 12 miles southeast of Mt. Toby and the tracks match rather closely in size, there is a possibility that the above records were produced by the same animal.

These seem to be the only authentic recent records of moose in this part of New England. Goodwin (1936) thinks that they are supposed to have occurred in this region in pre-colonial times. Emmons (1840) said that "The moose is not found at present within the limits of this state, neither has it probably been taken within its bounds for the last 40 years." Allen (1869) stated that "The moose undoubtedly existed in Massachusetts, though it has now been long extinct here"; and "Two of the four species of Cervidae (moose and caribou) have not existed in the southern half of New England since the discovery of the continent by Europeans, except in the mountains of western Massachusetts, and there probably only as occasional migrants from the contiguous regions north."

The presence of these animals now seems to be explained by their escape from semi-captivity on a large estate that once existed in what is now the October Mountain State Forest, in the towns of Lenox and Lee, central Berkshire County. Exact dates are not available, but as nearly as can be ascertained the moose were brought in about 1910 or 1911 and liberated in a large enclosed area. The owner later abandoned the estate and the animals escaped or were liberated, and spread over the Berkshire Hills, where some probably exist today. From Berkshire they could easily have wandered into Franklin County, which lies at the northern border of the state and is quite hilly, crossed the Connecticut River Valley, which is comparatively narrow in the hilly parts of that county, and gained access to the Pelham Hills on the eastern edge of the valley. The Berkshire and Pelham hills are now quite heavily wooded, and there are several fairly isolated ponds and abandoned meadows that would afford adequate shelter for limited numbers of moose. Another possibility is that some of these animals may have strayed in from the north, and Goodwin's (1936) record from New Ipswich, New Hampshire, points toward that conclusion.

The writer wishes to acknowledge the assistance of Professor E. C. Driver of Smith College in reading this manuscript.

LITERATURE CITED

ALLEN, J. A. 1869. A Catalogue of the mammals of Massachusetts with a critical review of species. Bull. Mus. Comp. Zool., no. 8, pp. 143–257.

CRANE, J. 1931. Mammals of Hampshire County, Massachusetts. Jour. Mamm., vol. 12, pp. 267–273.
EMMONS, E. 1840. Quadrupeds of Massachusetts. Cambridge.
GORDON, C. E. 1908. Otter in Massachusetts. Science, N.S., vol. 28, no. 728.
GOODWIN, G. G. 1936. Big game animals of northeastern United States. Jour. Mamm., vol. 17, pp. 48–50.
HATT, R. T. 1930. The relation of mammals to the Harvard Forest. Roosevelt Wild Life Bull., vol. 5, pp. 626–669.

Massachusetts State College, Amherst, Massachusetts.

PARTURITION IN THE DEER-MOUSE

BY FRANK H. CLARK

Parturition in the deer-mouse, *Peromyscus maniculatus artemisiae*, has been described by Svihla (Univ. Michigan Mus. Zool. Misc. Publ. no. 24, 1932), who stated that he has witnessed the process in deer-mice on several occasions. My own observations, although not extensive, seem worth recording, since the three females observed differed so markedly in their behavior during parturition.

The first female, from a stock of *Peromyscus maniculatus nebrascensis*, trapped by B. T. Ostenson, near Kelso in the sandhills of Nebraska, started to give birth to a litter as she was being transferred to a clean cage by a laboratory worker. The first young mouse apparently was born dead and had been partially eaten. As I arrived upon the scene a moment later she was giving birth to a second young. The mother stood on her hind legs and contracted her abdominal muscles to aid in the expulsion of the young mouse. As the head of the latter appeared, she reached down and clasped the young with her front feet and gently pulled. She removed her paws and then repeated the process, and the third time succeeded in pulling the young completely free. While clasping the young mouse with her feet she kept her head high in the air. Six young were born in rapid succession, all within a period of about 15 minutes, and in each case the mother used her fore feet to aid in the delivery of the young. She did not clean the young as they were born but left them scattered about the cage, although she did devour the afterbirth. In between births, the female washed her front paws and face and licked her genitals. Several times she rested her front feet on the back of her mate and closed her eyes, as though she were resting or in pain. The male remained close by during most of the time, but occasionally he ran about the cage. The female did not resent the presence of the male, and the latter did not molest the young except by accidentally treading upon them. Perhaps because of the fact that the female had been transferred to a clean cage, she ignored the young for a long time, but finally built a nest of cotton and nursed the three surviving young.

The second female observed was a hybrid from a cross between *P. m. nebrascensis* and a mutant yellow *P. maniculatus* strain descended from F. B. Sumner's stocks. It was seen that this animal soon would give birth to a large litter, and the cage was examined frequently during the day. Finally, at 2:30 P.M. one young was found in the cage, and 25 minutes later a second young mouse arrived. This mother behaved quite differently from the first female. She squatted in a somewhat hunched position on the floor of the cage, and did not stand erect. Her mate lay asleep beside her and apparently took no interest in the momentous occasion. As the head of the young one appeared, the mother placed her fore-paws on each side of the vulva and cleaned the young one by licking it. She did not seem to grip the young mouse with her teeth and pull it out in the manner that Svihla described for a female of *P. m. artemisiae*. She licked the mouse vigorously and prodded it with her nose, thus aiding in its birth. As the afterbirth appeared, she devoured it and in one case was seen to start at the placenta and systematically eat the umbilical cord down close to the newborn mouse. According to Svihla the umbilical cord is broken by stretching but in this case it appeared as though the female severed it with her teeth, either intentionally or unintentionally. Seven young finally were born, the approximate intervals in minutes between individual births being 25+, 25, 25, 10, 15, and 5 respectively. Each young mouse was cleaned during and after birth, and between births the female repeatedly washed herself. Within a few minutes after the last young arrived she had them all in a nest and was crouched over them.

The third female was from a stock of *P. m. osgoodi* trapped by L. R. Dice in the vicinity of Bismarck, North Dakota on an expedition financed by the Carnegie Institution of Washington. When seen to be pregnant, she was placed on the table for observation. At 4:00 P.M., one young already had been born. At 4:05, the female gave birth to another young. She crouched in the quadrupedal position and contracted her abdominal muscles. As the head of the young mouse appeared, she smelled it but did not clean it nor grasp it with her teeth. When the young mouse was almost free she appeared to reach down, grasp the umbilical cord close to the mouse with her mouth, and simultaneously pull free the young and the afterbirth. The attachment of the umbilical cord to the young was broken, probably by stretching, and the female ate the afterbirth, then cleaned her offspring and carried it to a corner of the cage.

The female still was conspicuously gravid and apparently in pain. She ran about the cage, chewed at the wire on the bottom of the cage, nervously picked up her young and then laid them down again. Occasionally she took a drink of water and stretched out flat on her abdomen with legs extended. At intervals she washed herself thoroughly and inspected her genitals as if looking for another young to appear. One hour and 20 minutes passed and since no more young had been born, the female was left until morning.

The next morning the female was nursing her two young and apparently

no others had been born, but she still looked pregnant. To my surprise, when I looked at her again in the afternoon, a third young was found. Since there was no bedding in the cage and I had picked the female up when looking for young in the morning, it seems certain that this third young was born later in the forenoon. This shows that at least 15 hours may elapse between consecutive births of litter mates.

Since the three females used in this study and the one used by Svihla all belong to different races, the differences in parturitional behavior may be either individual or racial ones. It is well known that mice exhibit great individual and racial differences in temperament and behavior. For this reason, it is unwise to attribute a certain behavior pattern to a group of animals of the same species or even of the same subspecies from limited observations on a few animals. Possibly a study of parturition in a large number of deer-mice would reveal variations in behavior quite different from those described here.

In these three cases, parturition took place in the day-time, but there is no evidence to show whether or not parturition occurs most often at night or during the day.

Laboratory of Vertebrate Genetics, University of Michigan, Ann Arbor, Michigan.

THE HOUSE RAT AS AN ENEMY OF THE BANK SWALLOW

By Dayton Stoner

In the course of banding and life history studies on the bank swallow (*Riparia r. riparia*), which Mrs. Stoner and I have conducted for more than 10 years, I heretofore have encountered but a single mammalian predator of this bird. In the Oneida Lake region of New York the common skunk (*Mephitis nigra*) was found destroying both the eggs and young (Stoner, D., Roosevelt Wild Life Annals, vol. 4, pp. 122–233, 1936). While this predation usually is more or less local, it sometimes attains such proportions as to constitute a serious menace to the success of certain breeding colonies.

Recently I have come upon another mammalian predator of this subterranean nesting bird. My first suspicion that some mammal other than the skunk might be doing the damage was aroused on May 22, 1936. While inspecting the interior of the burrows in a large bank swallow colony in the steep, sandy banks of Fish Creek, about 5 miles east of Oneida Lake, I detected in one of them the dead bodies of two adult birds. A small mirror was used to reflect a beam of light from the sun into the burrow, thus illuminating its deepest recesses.

This burrow was 28 inches deep, 14 inches below the top of the bank, and held a partially completed nest of grass, straw and rootlets. On recovering

the carcasses of the swallows with the aid of a long bent wire I discovered that neither bird had been dead for long. One swallow was unbanded; the tarsus of the other carried U. S. Biological Survey band no. 34/48502. As a matter of interest it may be mentioned that both this bird and its mate had been banded by us in this colony on May 22, 1935—just a year, to the day, previous to the discovery of the dead body.

The steepness of the bank, the fine sandy nature of the soil, which offered little foothold for an animal with much weight, and the lack of any opening to the burrow in the turf above it, led me to suspect that a weasel might have been the offender.

A few minutes later, in the same sector of the colony, I discovered two more dead adult bank swallows in another burrow 32 inches deep and 12 inches below the top of the bank. Upon recovering the bodies in the same manner as before, one of the swallows was found to be unbanded while the other carried band no. F55924. This individual had been banded by us as an adult on June 22, 1932, from a burrow within a few feet of the one in which it was now recovered. It, therefore, had attained a known age of at least 5 years.

Most of the fleshy part of the body of both birds, as well as a part of the skull, was missing, apparently having been devoured by some animal. There remained only the wings still united by the bones of the pectoral girdle including the sternum, the tail, a part of the vertebral column, the legs, and a few pieces of skin bearing feathers.

During the course of the morning there were found in this small sector of the colony a total of 10 dead bank swallows—4 pairs and 2 single individuals. At least 6 burrows, therefore, had been invaded by the unknown enemy.

On May 25 we visited the same colony, and in the same sector as before we discovered 6 more dead birds in the burrows. None of them bore bands. The swallows exhibited varying stages of mutilation; indeed, a small wound surrounded by clotted blood on the right side of the thorax was the sole external evidence of attack on 3 individuals. In the case of the most completely mutilated bodies only the skull, wings, feet, tail and a very little of the soft parts remained.

Following my first discovery of pillaged nests on May 22, I had smoothed off the sand below two occupied burrows. This procedure eliminated all projecting ridges or other possible support for a small marauding animal and, at the same time, rendered likely the detection of any marks, should some animal other than bank swallows have attempted to enter the burrows. On May 25 there were several long, narrow grooves, evidently claw marks, on this smooth area. The swallows in these burrows were unharmed, however, and the mystery still remained unsolved.

I visited the colony again on May 26 and found 4 more dead swallows, thus bringing the total number of known casualties to 20. In addition, I discovered the animal responsible for the destruction.

While inspecting the interior of the burrows as on former occasions, in one I caught a glimpse of the head and beady eye of a small mammal, which at first glance I thought was a meadow mouse (*Microtus*), busily engaged in feeding upon a hapless bank swallow. Hoping to capture the animal by impaling it, I hastily thrust a sharply pointed stick into the burrow. But I had not observed that this burrow had two openings and from the other there bounded a large house rat (*Rattus norvegicus*). With a grunt the animal ran down the bank, dashed unhesitatingly into the water of the creek, dived and was gone.

Of the scores of bank swallow colonies visited by us in the region, this was the only one in which casualties of this type were observed. Evidently the rat did not feed on eggs of the bird, for in several nests containing its victims the eggs remained unmolested.

So far as I am able to ascertain this is the first time that the house rat has been recorded as an enemy of the bank swallow. The general prevalence and abundance of the rodent, however, together with its destructive qualities, render it a potential enemy of no small consequence. The species, nevertheless, can not necessarily be condemned on the score indicated. Probably a single individual had in some way acquired the habit of visiting the colony and of availing itself of the abundant supply of animal food that it offered.

New York State Museum, Albany, New York.

THE PRESERVATION OF MAMMAL SKINS IN THE FIELD

By James Lippitt Clark

So many mammal skins, ranging in size from mice to small deer, come to our institution from the field in such extremely bad condition that I am prompted to write suggesting a most practical method for preserving these skins in the best possible manner. Being in charge of the preparation and the remaking of such specimens after they have reached the American Museum, I am familiar with the difficulties encountered in saving the slipping hair and loosened nails, and aware of the great amount of time involved in their careful relaxing and handling incident to making them into study skins. The logical and more constructive thing to do would be their better care in the field, in order that skins may be returned to institutions in the best possible condition.

The time of the collector in the field is precious and should be spent in the securing and skinning of specimens; not in making them up. This particular work can be done better and more economically at home by himself or by less expensive preparators. The poor condition of specimens may be the result of many causes, such as the inexperience of collectors, or the adverse

conditions under which experienced collectors may have had to work. It is the obligation of scientists and institutions to inform the inexperienced man how properly to collect and care for specimens.

After this we can assume, for the time being at least, that the animals have been properly taken and properly skinned, so that the method and attendant results of the preservation of skins can be discussed without further consideration of the problems of collecting.

Immediately the skin is freed from the body of the animal it is treated with dry common table salt. This is applied to the moist inner surfaces of the skin. The pads of the toes and feet on small mammals may be opened, but not necessarily skinned out, and the salt applied within these openings.

If the skin be greasy, as much of the grease as possible should be removed by scraping or cutting away with a knife. Much dry salt, well rubbed in, will help to absorb the grease. Ears, if large, should be opened up the back and turned inside out; if small they may be pierced at frequent intervals with a needle to allow the salt to penetrate the inner tissues through the epidermis.

A non-corrosive wire, or preferably a small sliver of bamboo, rattan, or some similar tough woody fibre, may be inserted in the tail; but before inserting permanently, this particular piece of wood should be moistened and dipped in the dry salt and then inserted into the tail several times to insure the inner surfaces of the skin receiving sufficient salt. Care should be taken that the salt reaches clear to the tip, and when this is assured the stick is again inserted to the tip and allowed to remain there.

After this dry salting, which cures the skin, it may be rolled up for 6 to 12 hours and left in a cool place, but not allowed to become dry. After this period of salt-curing the skin, with a non-corrosive identification tag attached, is then opened and immersed in the solution I am suggesting, in which it is to remain for an indefinite time.

This solution is a carrying solution and is made of water, 14 parts, salt 4 parts, and alum 1 part. It may be made in any quantity and kept on hand, preferably in glass, an earthen jar, wooden cask, or a non-corrosive metal container. Often in the field it is possible to obtain native beeswax with which to make such a tin water-tight and non-corrosive. To do this the tin is heated, insufficiently to melt the solder, but enough to fuse the wax, which is poured within and washed around until it contacts the entire inner surface of the tin, and then poured out, leaving a thin coating to congeal and insulate the tin against corrosion. The outside should be treated in a similar manner.

The solution when placed in a proper container is then ready to receive the skins. When introducing the latter, they should be moved about to insure contact of the solution with all surfaces, and then allowed to rest for an indefinite time. When the container has become filled with skins, all the liquid may be poured off to be used again, if desired, while enough liquid remains around the skins and the hair to keep them sufficiently damp for transporta-

tion. These containers when sealed can be properly crated or boxed and can be transported with safety to the home institution, where experience has proved that they will arrive in fine condition.

The advantages of this method of preserving are many. It permits the collector to give all of his time to the collecting and skinning of specimens. The bulk of a great number of skins is much less than would be the case if they were made up as study skins, or even sun dried as flat skins. The time and care necessary to dry skins is entirely eliminated. The skins are completely protected from the ravages of insects and damage incident to chafing and deterioration from the time they are placed in the solution. They are completely protected from climatic conditions, such as extreme moisture or heat. The treatment makes for the most permanent skin. It eliminates the handling of any poison in the field, and it reduces the outfit for preparation to alum, salt, and skinning tools.

Skins of this kind when packed will stand a great deal of heat, as proved by the fact that if one has a skin that is slipping badly, or a specimen that has begun to slip before skinning, and it is dipped for three or four minutes in this solution heated to a point at which one may hold his hand submerged, the alum and salt therein will "pinch" the hair so that the skinning can be carried on without the specimen suffering further.

Dry alum should never be used on a skin, for in this form it is a very severe astringent. It should always be used in solution, unless in extreme cases when the saving of the hair is all important.

Having had this theory regarding the care of small mammals skins for some time, I was anxious for the opportunity of putting it to a test. My chance came this spring when I went to Indo-China as co-leader of the Fleischmann-Clark Expedition. Here was extreme heat, often 100 degrees in the shade, where humidity also was very high, and, like the heat, varied but little throughout the twenty-four hours. The situation probably was as unfavorable as would be encountered under normal conditions. Skins dried during the heat of the day, if the sun was out, but again became almost wet at night. I feel positive I could not have saved the small mammals that I collected during the latter part of the trip had I not used this method. At the present time these small specimens are being made into study skins. Coming from the solution there is no sign of slipping hair or of grease burn, and they handle like fresh skins. A thorough washing in fresh water to remove the salt and alum from the hair also eliminates much of it from the skin. As the specimen is properly cured, it may be poisoned in any manner preferred by the preparator.

As a result of this procedure one may build up a collection of perfect skins, free from grease, suitable for mounting at any time, and one that really can be handed down to posterity: not one in which many of the skins are disintegrating from grease.

Strange as it may seem, bird skins taken in the field may be handled in the

same manner. Although I have never tried this method with birds in the field, I see no reason why it can not be done if conditions at the time suggest its desirability.

Mr. George G. Goodwin, of the American Museum, believes that all inexperienced collectors should handle their field skins in this way, but that experienced men when operating under favorable conditions would prefer to make directly into study skins all mammals smaller than rabbits, unless they are particularly greasy.

American Museum of Natural History, New York, N. Y.

A NEW CANYON MOUSE OF THE GENUS PEROMYSCUS FROM ARIZONA

By E. A. Goldman

Study of the canyon mice of the genus *Peromyscus* in Arizona has resulted in the segregation of a new geographic race with a well-defined range, including the Grand Canyon region. The new form may be known by the following description:

Peromyscus crinitus peridoneus, subsp. nov.

Grand Canyon Mouse

Type.—From Bright Angel Trail, 4800 feet altitude, south side of Grand Canyon, Coconino County, Arizona. No. 202,424, ♂ adult, skin and skull, U. S. National Museum (Biol. Surv. coll.); collected by E. A. Goldman, August 19, 1913. Original number 22,145.

Distribution.—Both sides of Grand Canyon and north at least to Beaver River Valley, southwestern Utah.

General characters.—Similar in size to *Peromyscus crinitus crinitus* of Idaho, but pelage shorter; color lighter, the upper parts less heavily overlaid with black; tail brownish instead of black above. Somewhat smaller and decidedly darker than *Peromyscus crinitus auripectus* of the Painted Desert region, the upper parts less rich ochraceous buff than in that subspecies. Differing from *Peromyscus crinitus stephensi*, of the desert region of southeastern California, in larger size and darker color, the upper parts suffused with darker buff.

Color.—Type: Upper parts near pinkish buff (Ridgway, 1912), purest on cheeks, shoulders and along sides, moderately mixed with black on top of head and over back; entire under parts white; more exposed parts of ears dusky, the longer hairs clothing the basal portions distinctly buffy; feet white; tail sharply bicolor, dark brownish above, white below. In some specimens a buffy pectoral spot is present as in *auripectus* and typical *crinitus*.

Skull.—About like that of *P. c. crinitus* in general size and form, but interparietal smaller, less extended antero-posteriorly. Very similar to that of *P. c. auripectus*, but somewhat smaller. Compared with that of *P. c. stephensi* the skull is larger, the braincase decidedly broader, and zygomata more widely spreading; interparietal relatively shorter, less extended antero-posteriorly.

Measurements.—Type: Total length, 176 mm.; tail vertebrae, 97; hind foot, 21.5. Average of 10 adults from Shinumo Creek (3000 feet), north side of Grand Canyon, Arizona: 172.5 (163–178); 98 (91–106); 20.5 (19.5–21). Skull (type): Greatest length, 24.8; zygomatic breadth, 12.2; interorbital breadth, 4.4; length of nasals, 9.8; length of incisive foramina, 4.2; length of palatal bridge, 3.6; maxillary toothrow (alveoli), 3.5.

Remarks.—*Peromyscus c. peridoneus* is distinguished from any of the nearly related forms of *P. crinitus* by a combination of color and cranial details. There is evidence of intergradation with typical *crinitus* toward the north, with *auripectus* toward the east, and with *stephensi* on the west. Specimens from the northern and southern sides of the Grand Canyon appear to be identical.

Specimens examined.—Total number, 36, as follows: **Arizona:** Fredonia, 1; Grand Canyon (near Bass Camp, 3000–5200 feet), 3; near Grand Canyon Spring, 4000–7500 feet, 9; Betatakin Canyon, 3; Bright Angel Creek, 3 miles above mouth, 1; Bright Angel Trail, south side, 4800–6500 feet, 2; Shinumo Creek, 3000 feet, 12; Nankoweap Valley, 1. **Utah:** Beaver River, near Fort Cameron, 3; Parowan, 1.

U. S. Biological Survey, Washington, D. C.

A NEW, LOWER OLIGOCENE, AMYNODONT RHINOCEROS

By Horace Elmer Wood, 2nd

This description of an intermediate link between the American Upper Eocene species of *Amynodon* and *Metamynodon planifrons* of the Middle Oligocene, is an excerpt from an incomplete revision of the Amynodontidae (part of a project which has been assisted by a grant from the Penrose Fund of the American Philosophical Society) and published here at the request of Professor W. B. Scott to render it available for quotation in part III of his report, "The Mammalian Fauna of the White River Oligocene," now in preparation.

Metamynodon chadronensis, new species

Synonymy.—*Metamynodon* sp. Matthew, 1909.

Type and type locality.—Amer. Mus. no. 11,866, consisting of both rami of the lower jaw, with the cheek teeth, from the Chadron Formation (Lower Oligocene) of Quin Draw, South Dakota.

Diagnosis.—$1\frac{?}{?}$, $C\frac{?}{?}$, $P\frac{2}{2}$, $M\frac{3}{3}$; considerably smaller than *M. planifrons*, a shade larger than *Paramynodon cotteri*; lower molars smaller, more brachyodont, less flattened laterally, and more primitive in pattern, than in *M. planifrons*; thin layer of cement on lateral surfaces of cheek teeth.

Matthew (in Osborn, Bull. U. S. Geol. Surv., no. 361, p. 104, 1909) cited *Metamynodon* sp. from the Chadron, evidently on the basis of Amer. Mus. no. 11,866, consisting of a lower jaw lacking the incisors and canines, collected in 1903 by H. F. Wells in the Lower Titanotherium Beds of Quin Draw, 4 miles from the Cheyenne River, Big Badlands, South Dakota. Mr. Wells can hardly be supposed to have been unable to distinguish between Chadron and Brule, and, in any case, the matrix is the typical greenish sandstone which fills channels in the Chadron clays. Preparation of the specimen showed that it is intermediate in size and character between *Paramynodon cotteri* of Burma and *M. planifrons* of the Lower Brule, being closer to the former in size. It is referred to

Metamynodon on the basis of geographic probabilities, and of its known characters. Whatever genus it best may match when the skull and upper teeth are found, however, it is clear that it represents a new species, intermediate between the most advanced earlier American forms and *Metamynodon planifrons*, and that there is a native American line of amynodonts which is almost monophyletic.

This specimen is slightly larger than *Paramynodon cotteri* and definitely smaller than small individuals of *Metamynodon planifrons*. A thin outer coating of cement appears on the external surfaces of the teeth. $P_{\overline{3}}$ is reduced, as in these two forms, but the talonid crescent is a shade less atrophied than in *Metamynodon*. $P_{\overline{4}}$ is slightly less degenerate than the usual condition in *M. planifrons*, as the paraconid region is not yet reduced to an antero-posterior blade, but still has an internal ridge descending posteriorly and nearly reaching the metaconid. The molars are definitely less hypsodont, are less laterally compressed, and are more like advanced species of *Amynodon* than in *M. planifrons*. Each molar is noticeably smaller than the corresponding tooth in *M. planifrons*, and the accumulated difference for the molar series is striking. The molars have small internal cingula at the outlets of the talonid valleys, producing internal bulges in their outlines; but these bulges are less pronounced, especialy on $M_{\overline{2}}$, than in *M. planifrons*, although better developed than in *P. birmanicus*. $M_{\overline{3}}$ still has the posterior cingulum fairly well developed, as compared with *M. planifrons*; it is further reduced than in *A. intermedius*.

FIG. 1. *Metamynodon chadronensis*, new species, crown view of right $P_{\overline{3}} - M_{\overline{3}}$ of Amer. Mus. no. 11, 866, x½; drawing by Dr. Florence Lowden Wood.

Measurements, in millimeters of holotype of Metamynodon chadronensis, n. sp.

	R.	L.		R.	L.
Jaw below $P_{\overline{3}}$		est. 70	AP.$P_{\overline{4}}$	26.3	26.8
Jaw below $M_{\overline{3}}$ (crushed)	80.2	80.6	Tr.$P_{\overline{4}}$	est. 18.5	19.1
$P_{\overline{3}}-M_{\overline{3}}$	183.5	178.3	AP.$M_{\overline{1}}$	33.9	33.5
$P_{\overline{3-4}}$	40.4	41.6	Tr.$M_{\overline{1}}$	25.4	23.5
$M_{\overline{1-3}}$	144.1	141.8	AP.$M_{\overline{2}}$	50.2	47.4
AP.$P_{\overline{3}}$	18.8	17.1	Tr.$M_{\overline{2}}$	27.8	27.7
Tr.$P_{\overline{3}}$	13.3	13.0	AP.$M_{\overline{3}}$	59.0	59.3
			Tr.$M_{\overline{3}}$	24.9	25.8

University of Newark, Newark, New Jersey.

GENERAL NOTES

A SIMPLE METHOD OF SAVING SMALL MAMMALS IN THE FIELD

Having read in manuscript the article in the present number of the Journal by Mr. James L. Clark, "The Preservation of Mammal Skins in the Field," I would like to suggest a simpler method of caring for small mammals that might meet the needs of amateur collectors, particularly in the temperate parts of North America.

It has been our experience in the Biological Survey that skins of certain small mammals, particularly chipmunks and squirrels, after being salted in the field and later washed in the laboratory, frequently lose much of the brilliancy of the natural colors, the brown or reddish shades, particularly, becoming noticeably altered. Small mice or shrews with slender tails are sometimes received after having been dried flesh side out. Such specimens require a considerable expenditure of time and labor to prepare them for the cabinet, and never can be made to look quite right. Rabbits, also, when salted and washed, require much labor in their preparation, especially if the sides of the skin and of the tail have been allowed to stick together.

The method that I would suggest for caring for small mammals in the field is as follows: As soon as the skin is removed from the body and cleaned of as much fat as possible, brush the flesh side of the skin *while damp* with powdered borax and turn the skin right side out; in animals the size of a woodchuck the pads of the feet should be slit and borax inserted; select a slender splint of wood or bamboo, or a broom straw, moisten it, dip in borax and insert in the tail to the very tip, leaving it there; in animals the size of a chipmunk or larger, make 2 or 3 slits of half an inch on the under side of the tail, and in mice or shrews, make one small slit about half an inch from the end of the tail, in order to allow air to penetrate and help dry the tail; fold up several thicknesses of newspaper about the width of the body and insert this flat strip in the skin all the way to the nose; if paper is not available, fine dry grass may be utilized; foreshorten the skin by slightly stretching it sideways, fold the edges together along the belly, smooth out the skin and arrange the legs and tail in natural shape, fasten a tag to it with data, and lay it out on a board to dry. The skull should be tagged and hung up to dry, after removing some of the brain with a bent wire. So prepared, the skins will take up little room, and may easily be transported to the home base; on arrival they are available at once for identification, or they may readily be relaxed and made into perfect specimens.

The obvious advantages of this method are its simplicity, the elimination of special or heavy equipment, the saving of time in the field, and the ease of transportation. It is not intended to be used by experienced collectors having adequate field equipment, but should be of use to hunters or tourists who desire to save occasional specimens of interest or value to science.—Arthur H. Howell, *U. S. Biological Survey, Washington, D. C.*

SOREX DISPAR IN NEW HAMPSHIRE

While examining the accession catalogue of the Boston Society of Natural History, I discovered a record of this shrew taken by Glover M. Allen on August 22, 1927, in Kinsman Notch, four miles west of North Woodstock, New Hampshire. Previous records of the capture of this species are those of D. W. Mather (Jour. Mamm., vol. 14, p. 70, 1933), and of Alexander Lincoln, Jr. (Jour. Mamm., vol. 16, p. 223, 1935), who collected specimens in Tuckerman's Ravine, Mount Washington, in June and August, 1932, and contributed these as possible state records.

At the time of Dr. Allen's visit two individuals were secured (no. 1163, Bost. Soc. Nat. Hist., and no. 23,926, Mus. Comp. Zool.). Dr. Allen has kindly given me permission to publish this note.—Norman A. Preble, *Wakefield, Massachusetts.*

PENNSYLVANIA RECORDS OF SOREX CINEREUS FONTINALIS

In 1928, Hartley H. T. Jackson, in his "Taxonomic review of the American long-tailed shrews," accorded full specific rank to *Sorex fontinalis* Hollister, stating, however, that "it is possible that when specimens are available from the region between the type locality and the mountains of Maryland and Pennsylvania, or from northeastern Maryland and Delaware, intergradation between the two forms may be shown". Unfortunately, two specimens listed in his work as *Sorex cinereus cinereus* from Kennett Square, Pennsylvania, appear to be flat skins without skulls or measurements.

Since 1928, several specimens of the *Sorex cinereus* group have been collected in the lowlands east of the Appalachian Mountains, in the region where these intergrades naturally would be expected. These specimens seem to support Dr. Jackson's prediction and show a definite intergradation between the two forms, evidently indicating *fontinalis* as a smaller eastern lowland form of the *cinereus* group, occupying the region in eastern Pennsylvania, Maryland, Delaware, and possibly New Jersey, between the typical form and the dark race of the Atlantic tidal marshes, *Sorex c. nigriculus* Green.

Mr. Morris Green, who captured two specimens of the *Sorex cinereus* group at Keeny, Delaware, in 1924 and 1927, regarded these individuals as nearer *S. cinereus fontinalis*, and just as typical of this form as a series taken by Mr. Ralph Jackson at Cambridge, Maryland.

More recently three specimens have been taken in northern Chester and southern Berks counties, Pennsylvania, which in external and cranial measurements are clearly closer to *fontinalis* than to typical *cinereus*. Two of these, taken at Ridgewood near Reading, Berks County, are in the Reading Public Museum collection, while the third, taken by M. V. Ayer near Cedarville, Chester County, is in the collection of the Philadelphia Academy of Natural Sciences. Two other specimens, taken by the writer in the Blue Mountains of northern Berks County, are clearly intermediates.

Thus we now have a series showing an unbroken gradation between typical *Sorex cinereus cinereus* of the higher Pennsylvania mountains, and "*Sorex fontinalis*" indicating that the latter form should properly stand as *Sorex cinereus fontinalis*. Incidentally its occurrence in Pennsylvania adds a new subspecies to the state list.—Earl L. Poole, *Reading Public Museum, Reading, Pennsylvania.*

NOTES ON THE BEHAVIOR OF THE CALIFORNIA LEAF-NOSED BAT

While engaged in field work along the Colorado River, 14 miles east of Searchlight, in southern Clark County, Nevada, I had the good fortune to observe something of the behavior of the leaf-nosed bat (*Macrotus californicus*). The collecting party, of which I was a member, was camped in Cottonwood Valley at a deserted ranch which included within its confines numerous outhouses and an underground vegetable cellar.

At 9:30 P.M. on the evening of January 15, 1934 (the first warm evening of the trip, with a minimum temperature of 54 degrees Fahrenheit at Needles, 31 miles south), one of the party noted that bats were flying low about the ranch yard, and in and out of one of the outhouses. Investigation revealed that the bats were "hanging up" on the sides of the rafters of the building. Individuals were present in two of the buildings, one of which was the underground cellar. It was noted that the bats chose as resting places rooms that offered the most protection from the cool night air. As many as 7 or 8 were present in a building at one time, but there was a constant fluctuation in numbers, new arrivals taking the places of departing individuals. Their presence in such an association seems to require modification of the view previously held (see Howell, Jour. Mamm., vol. 1, p. 172, 1920) that they are found in caves and old mines only.

It was rather difficult to capture the bats by hand, for apparently they were able to see us very well, and, when we stood in the doorway, the only available exit, they all

crowded to the opposite wall, where they alighted and watched us intently. Their relatively large eyes acquired a straw-yellow shine in the light from our flashlights. We finally captured some by knocking them down as they flew around in search of an exit. They sometimes bit when handled, but, unlike some other bats, at no time were they heard to utter any sound. When a sufficient number of specimens had been secured, we took the opportunity of observing some of the habits of those remaining.

It was noted that, in "hanging up," these bats make a half-turn roll. This action has previously been commented upon by Howell (*loc. cit.*). When at rest, their heads hang straight down, and their ears are pendulous. When disturbed, however, they elevate the head and raise the ears until these extend perpendicular to the body.

Those individuals prepared as specimens were found to have their stomachs greatly distended with food, and, since none were observed to be eating, it appears that they gorge themselves while flying, and then come to rest in order to digest the food which they have eaten. While droppings were found in nearly every out-building on the ranch, the fact that there was an almost complete absence of uneaten insect remains, such as beetle elytra or moths' wings, seems to lend weight to the above supposition. In this respect *Macrotus* differs from *Antrozous*, for the presence of the latter is often indicated by an abundance of such insect remains beneath its resting places.

An hour and a half later the bats had disappeared, whether because they had been disturbed or for some other reason I do not know. The next evening (January 16) several of them reappeared about an hour after sundown. None were captured, but each night fewer individuals appeared, until, on January 19, not one was to be found. Since this locality is near the northern limit of the known range of this bat, as recorded by Burt (Trans. San Diego Soc. Nat. Hist., vol. 7, p. 393, 1934), it is probable that they were not migrating. The minimum temperature became lower on each succeeding night until, on January 19, it reached 34 degrees Fahrenheit at Needles, so it seems likely that they temporarily had made this change in their actions either because of lower temperatures or because they were disturbed by our presence.

Both sexes were present, although females predominate in the series collected, with a ratio of 9 females to 2 males.—Donald M. Hatfield, *Museum of Vertebrate Zoology, University of California, Berkeley, California.*

NOTES ON THE BIG BROWN BAT

On April 21, 1936, a small colony of bats was observed in an old barn near Hammond, Louisiana. One of the bats was captured, but the others scattered. Upon my request, the workmen were instructed to leave the colony undisturbed. The animals failed to make their appearance, however, yet it was evident that there were fresh droppings under the roosting place. On April 28, all guano was cleaned up, but 2 days later there was a considerable amount of it present, although no bats had been seen at the roost. This state of affairs continued for a number of days, and it became evident that the bats were returning to the roost only at night. Finally, on May 8, it was decided to take night observations. Until 9 P.M. there was no evidence of any bats. At 10 P.M. there they were, a small colony of them, actively squeaking and jostling each other. They remained until some time between 2 and 3 A.M., for they were gone at the latter hour. The next night, at about 10 o'clock, the whole colony was captured. It consisted of 10 females of *Eptesicus f. fuscus*. All of these, and also the one captured on April 21, obviously were in advanced stages of pregnancy.

It has been noted before that apparently the environment may cause a hibernating bat to ovulate. Especially is this true if the bat be taken from hibernating quarters after February 1 and placed in a warm laboratory (see Guthrie, Jour. Mamm., vol. 14, pp. 199-216, 1933). If this be so, then it is natural to suppose that most of the females

of any one bat colony would ovulate at nearly the same time in the spring. This would lead to parturition by the females of any one colony within a relatively short period. In this particular case, all the females of the colony gave birth to young within a period of 48 hours. One female gave birth to one young before 6 A.M. on Saturday, May 16. An hour or so later a second young was born to the same female. By 6 o'clock that evening 4 of the 11 bats had produced young. By 6 A.M. the following morning 5 more had given birth, and by evening all but one had parturiated. The remaining bat gave birth before the next morning, May 18. The 11 bats had 23 young, and later examination showed these young to comprise 10 females and 13 males. Just how many young were born to each female could not be ascertained in every instance, for the majority of the bats were confined together. At least one female had a single young, and 3 other females had 2 apiece. The remaining 7 females produced 16 young.

This record furnishes evidence that all the females in this colony must have ovulated within a short time of each other, probably not more than 48 hours apart. It is hardly likely that any causative agent other than the environment would have induced ovulation almost simultaneously among all these females. This record also tends to support the theory that spring copulations are not necessary for fertilization, for it is rather beyond the range of possibility that all these bats would have copulated within such a short time. The most plausible explanation seems to be that as a result of fall copulations sperm had been stored in the uterus and oviduct, and that upon favorable spring conditions, ovulation had taken place with resulting fertilization, the same conditions affecting all females in the locality similarly, and eventually producing more or less simultaneous parturition.—WILLIAM H. GATES, *Louisiana State University, Baton Rouge, Louisiana.*

OCCURRENCE OF THE HOARY BAT AT HOT SPRINGS NATIONAL PARK, ARKANSAS

A new record of the hoary bat (*Nycteris cinerea*) for Hot Springs National Park and for the State of Arkansas, resulted from the finding of 2 specimens of this rare migratory bat early in 1936. The first of these, a female, measuring 5.5 inches in body length, and 16.5 inches in wing spread, was taken on February 12. It was found, frozen to death, clinging to a stone wall beside a much-frequented doorway at the park utilities building, where it must have hung for some time before it was noticed by Foreman W. F. Walters, who reported it to the writer. The abnormally cold weather that had prevailed for some 6 weeks had preserved the body, and a study skin was prepared and added to the collection in the park museum. How this bat could have remained unobserved in such a conspicuous location is understood only when the body is seen resting against the pink native sandstone walls. The maroon base color of the fur is brightened by the overlying white to produce a shade of pink that blends perfectly with the color pattern of the stone. Certainly this is a singular coincidence that the color of the bat and its place of repose should combine to provide almost unexcelled protective coloration.

On April 20, Mr. Barney Brown, Superintendent of the Hot Springs Water Company plant, discovered a live specimen of this species at his home on the grounds of the water plant. It died overnight in captivity, and the body was brought to the National Park office, where it was prepared for addition to the collection. This bat had a body length of 4.75 inches, and a wing spread of 15.75 inches.—H. R. GREGG, *Hot Springs National Park, Hot Springs, Arkansas.*

KILLING TECHNIQUE OF THE WEASEL

The following observations were witnessed by Prof. G. M. Longenecker, Mr. Donald McBeath, and myself. On June 3, 1935, we were driving very slowly along an unfrequented road on the University Arboretum near Madison. From the grass 20 feet ahead

of us at the side of the road a cottontail rabbit, about one-third grown, appeared and came hopping toward us. On his trail and about 10 feet behind him was a weasel. I hurriedly stopped the car and we all leaned out of the open windows, but barely in time to see the action, which took place when the cottontail was directly alongside the car and 4 feet away. At this spot he turned again into the grass and just then the weasel overtook him. Evidently sensing our presence, the latter struck the rabbit on the run, and without any pause continued out of sight into the dense growth. The cottontail squealed, collapsed, and lay kicking, a small patch of blood showing at the base of its skull. The incredible swiftness of the action is still vivid in our minds.

The weasel returned several times within 4 feet of the expiring rabbit to size up the situation, then finally moved in to its kill. The rabbit squealed a second time, evidently as he received the final *coup de grace*. Then came the blood-licking, the weasel sucking or licking the wound and the blood which had spilled on the rabbit's fur. This lasted several minutes, but was conducted with such swift dexterity that it was hard for the eye to follow the details.

Apparently the weasel was not satisfied with our presence, for he picked up his prey and loped off about 15 feet to the base of a roadside tree. This was an amazing feat. The rabbit must have weighed twice as much as the weasel. One might liken it to a terrier loping off with a sheep, but there was no indication that the load placed the slightest strain on the weasel's speed or strength.

The blood-sucking now continued, but not in plain sight. One of us, in an effort to see, made a slight noise, which caused the weasel to rear up for a look around. By this action one could clearly see that his snowy chin and throat were entirely free of blood stains, another evidence of the skill with which the whole job was executed. The situation evidently was unsatisfactory to the weasel, for again he picked up the rabbit and with effortless bounds disappeared into a dense patch of nettles.—Aldo Leopold, *College of Agriculture, University of Wisconsin, Madison, Wisconsin.*

FUR SEALS OFF CALIFORNIA

During the past winter (1936), fur seals (presumably *Callorhinus alascanus*) in some numbers were seen by T. T. McCabe and myself off shore from Santa Cruz, California. We first encountered them February 28. They comprised females and cubs in twos and threes, asleep on the surface, and they permitted an extraordinarily close approach by the launch before awakening. On March 14 we saw more of them, from 2 to 25 miles offshore from Santa Cruz pier, the greatest number occurring at a distance of about 12 miles. They were mostly in small pods, the largest group consisting of 8 individuals, and but few occurred singly.

When asleep the animals lay on their backs side by side, often actually touching one another, with flippers idly flapping clear of the surface. On more than one occasion we approached within 20 feet before the seals awoke in a panic, first diving, then almost immediately reappearing and breaching like porpoises. One cub with a length of less than three feet skipped from the water in a leap of at least 10 feet. What appeared to be a young bull was seen within two miles of the pier; the rest were females and cubs.—Allan Brooks, *Okanagan Landing, British Columbia.*

THE FOOD OF THE FUR SEAL

The food of the fur seal, *Callorhinus alascanus*, during its northward migration along the Pacific coast of North America, has long been the subject of discussion, but little regarding it has been published. The items herein presented are not to be considered wholly representative of the food preferences of this animal, because of the small amount of material examined, but they should prove of value as an addition to the present sum total of our knowledge on the subject.

Through the cooperation of the U. S. Bureau of Fisheries, a series of 113 stomachs was received and examined at the Food Habits laboratory of the Bureau of Biological Survey. Of this number, 54 were from near Lapush, Washington, and 59 from near Sitka, Alaska. Twenty-seven of the Washington stomachs were empty, as were 47 of those from Alaska. This left 39 stomachs that contained food, the greater number of these being less than one-quarter full, and several nearly empty. Traces of vegetable debris, including bits of wood and seaweed, probably taken incidentally, were found in five instances, and in one nearly empty stomach this debris amounted to 5 per cent of the total contents.

Contents of 39 fur seal stomachs

SPECIES	NO. OF OCCURRENCES	PERCENTAGE OF TOTAL FOOD BY BULK
Crustacea		
Amphipoda (?)	1	trace
Thysanoessa sp.	1	trace
Thysanoessa spinifer	3	0.02
Decapoda (Caridea ?)	1	trace
Pagurus (*brandti* ?)	1	trace
Mollusca		
Cephalopoda (squid)	3	trace
Pisces		
Clupeidae (?)	5	10.26
Clupeidae (*Clupea pallasii*?)	16	41.03
Clupea pallasii	11	28.18
Undetermined animal tissue	8	20.51

Although inferences drawn from these data would at best be inconclusive, it appears that, in agreement with the findings of others, herring constitutes a major part of the diet of the fur seal during its northward migration along the Pacific coast of North America.—Franklin H. May, *U. S. Biological Survey, Washington, D. C.*

A CHIPMUNK CAPTURES A MOUSE

While working on the Soil Conservation Service Project located at Indiana, Pennsylvania, in May, 1935, I observed an interesting trait in the behavior of a chipmunk (*Tamias striatus*). I was driving along a country road two miles north of Indiana, Pennsylvania, when I saw a chipmunk a hundred feet ahead of the car suddenly dash from a grassy field across the road and down into a dry drainage ditch that lay between the road and a patch of woods. He was carrying something in his mouth that seemed rather large and burdensome. As my car reached the point along the ditch where he had disappeared, he suddenly darted up the farther side of the ditch, and disappeared in a hole under an exposed tree root, dropping his burden as he entered.

The chipmunk's prey proved to be a large meadow mouse (*Microtus pennsylvanicus*), which I prepared and sent as a specimen to the Philadelphia Academy of Natural Sciences, where it now is in their collections. Undoubtedly, the chipmunk had just captured the mouse, which was still warm, with fresh blood and tooth marks in the neck and in the back of the head. This occurrence appears to indicate an occasional penchant for a meat diet on the part of this rodent.—J. Kenneth Torres, *Section of Wildlife Management, Ithaca, New York.*

EXTENSION OF RANGE OF PEROGNATHUS FLAVUS FULIGINOSUS

The range of *Perognathus flavus fuliginosus* has been narrowly restricted to the "Lava beds in the vicinity of San Francisco Mountain, Arizona" (Osgood). This area is included in the volcanic fields of San Francisco Mountains, Arizona, an area predominantly of extrusive basaltic rocks bounded on the north by the Little Colorado River between Cameron and the mouth of Canyon Diablo, on the east by Canyon Diablo to its head, thence in a straight line to the head of Clear Creek, on the south by the north rim of the Verde Valley northwest to Ashfork, and thence to Cameron.

Recently Grater (Jour. Mamm., vol. 17, p. 170, 1936) reported taking *P. f. fuliginosus* from the stomach of a cat killed near the boundary of Grand Canyon National Park. Grater since has informed me that the cat was killed in Red Horse Wash, on Kaibab limestone. This locality is several miles north of the northwest boundary of the San Francisco Mountains volcanic fields, as outlined, but "Dog Knobs," basaltic cones and flows, are known to occur within four miles of the road across Red Horse Wash where the mouse was recovered (see Robinson, U. S. Geol. Surv., Prof. Paper no. 76, Plate III, 1913). This race of *Perognathus* previously has been found only on black volcanic soil, so it would not be expected to occur normally on light colored ground. It is more probable that the mouse was caught on dark colored soil.

Perognathus flavus fuliginosus has been taken nearby. In the Museum of Northern Arizona there is a specimen (Z9.83) taken by Lewis D. Yaeger, May 14, 1932, at Bly, near the 18 mile post on the railroad between Williams and Grand Canyon. Identification was made by E. Raymond Hall and Seth B. Benson. Basaltic flows also occur in this locality, which is only about 18 miles from the point where the cat in question was taken.

This specimen establishes the occurrence of *P. f. fuliginosus* in an area of normal ground color, about 40 miles airline northwest from the nearest previously trapped specimen. The taking of specimens in widely separated localities of rather uniform ground color and material postulates the occurrence of this race throughout the San Francisco Mountains volcanic fields wherever ecologic conditions are favorable.—LYNDON L. HARGRAVE, *Museum of Northern Arizona, Flagstaff, Arizona.*

DIPODOMYS DESERTI SONORIENSIS IN ARIZONA

On November 6, 1935, I collected six specimens of *Dipodomys deserti* on the desert about three miles east of Picacho, south central Arizona. Upon comparing them with specimens taken in California, it was seen that they are much grayer (less rufescent), thus conforming to the description of *D. d. sonoriensis.*

As the latter form was not represented in the Los Angeles Museum, two of the specimens were forwarded to E. A. Goldman, who kindly compared them with the series in the Biological Survey collection. Major Goldman advised us that the specimens are referable to *sonoriensis*, which form, I believe, has not previously been recorded from Arizona.—G. WILLETT, *Los Angeles Museum, Los Angeles, California.*

PEROMYSCUS LEUCOPUS ARIDULUS IN KANSAS

The presence of *Peromyscus leucopus aridulus* in Kansas has long been anticipated, since specimens indistinguishable from *aridulus* are found in Oklahoma (Osgood, W. H., North Amer. Fauna, no. 28, pp. 123–124, 1909; Jackson, H. H. T., and H. E. Warfel, Publ. Univ. Oklahoma Biol. Surv., vol. 5, nos. 1, 2, 3, 4, p. 71, 1933), and also because of the presence in northwestern Kansas of other members of its zonal predilections. During many years of collecting in this state, specimens of the *Peromyscus leucopus* group have never been taken west of Republic and Cloud counties, nor north of Barber County, leaving over one half of the area of Kansas with its fauna inadequately known.

While collecting for the Kansas University Museum during July, 1936, considerable time was spent along Beaver Creek in Rawlins County. Traps set along the stream bed around the drift in the timber yielded a large series of *P. l. aridulus* each night. Occasionally a few *P. m. nebrascensis* and *Reithrodontomys m. dychei* were taken in association with *aridulus*. As a rule the form *nebrascensis* was found confined to the slopes and the upland, where *aridulus* never was taken. The latter can be expected to occur over most of the northwestern part of the state, along the streams because of the more humid environment in this situation.

Specimens of the *leucopus* group from Republic and Cloud counties show intergradation with *aridulus*, inclining toward *noveboracensis* when compared with Kansas specimens. The specimens from Barber and Comanche counties have been referred to *P. l. tornillo*, but the latter are not typical, since there is intergradation with both *texanus* and *noveboracensis*. If *P. l. aridulus* extends across the state into Oklahoma, its distribution and place of crossing still remains unknown.—Claude W. Hibbard, *Museum of Vertebrate Paleontology, University of Kansas, Lawrence, Kansas.*

OCCURRENCE OF THE TEXAS RICE RAT IN OKLAHOMA

In August, 1934, while I was acting as mammalogist of a field party of the University of Oklahoma Biological Survey, the first Oklahoma specimens of *Oryzomys palustris texensis* were taken on Mountain Fork River, McCurtain County, 15 miles southeast of Broken Bow. Mountain Fork River is a tributary of Red River, and the record represents a substantial extension of range. The occurrence of the species in the Arkansas River Valley in Oklahoma has been predicted (Goldman, North Amer. Fauna, no. 32, p. 27, 1918).

Two specimens were taken, an adult and a juvenile. They were trapped in the river bottom on a flat covered with cane, *Arundinaria gigantea*. The altitude is about 500 feet. Although extensive trapping was done in this and similar situations, no others were taken.—H. L. Whitaker, *Soil Conservation Service, Salina, Kansas.*

THE COOPER LEMMING MOUSE IN SOUTHERN NEW HAMPSHIRE

From the fall of 1934 to the spring of 1936, I collected a series of lemming mice on a small area in Durham, New Hampshire. This mouse has not been recorded from this region of the state, and the series provides some needed information on the intergradation of *Synaptomys cooperi cooperi*, to the north and west, and *Synaptomys cooperi stonei*, to the south. There are 9 specimens in the series, one of which was collected by Philip L. Wright, Durham, New Hampshire. Of these, 5 are adult males, 3 are immature males, and one is an immature female.

A study of the 5 adult skulls shows that these lemming mice are intermediate between the Cooper lemming mouse and the Stone lemming mouse, although approaching more closely the characteristics of the latter. The upper incisors are fully as broad as in the form *stonei* and measure 1.7 mm., as compared with 1.1 mm. in typical *cooperi*. In general these skulls are broader and heavier than those of typical *cooperi*, and approach *stonei* in that respect.

With one exception these lemming mice were collected from the tunnels of the Brewer mole in a roadside association of grasses, weeds, and shrubbery. The immediate area has a dry loamy soil, although there are damp, almost swampy, spots within a radius of 100 yards. The mice were found to be using these particular mole tunnels in common with a number of other small mammals, as follows: Brewer mole (*Parascalops breweri*); star-nosed mole (*Condylura cristata*); short-tailed shrew (*Blarina brevicauda*); meadow mouse (*Microtus p. pennsylvanicus*); and the pine mouse (*Pitymys pinetorum scalopsoides*). This seems to indicate that the lemming mouse can survive in competition with other Microtinae.

The fact that immature specimens were collected in December, March, and April, indicates that in southern New Hampshire this mouse breeds throughout most of the year, with the exception, perhaps, of the coldest months.

A microscopic examination of the stomach contents showed that these lemming mice had eaten no animal matter. The stomachs contained very finely divided plant material, arranged in 3 masses of different color; dark green, greenish white and dark brown. The dark green mass proved to be composed of the fragments of grass blades and stems. The greenish white material apparently was the remains of delicate plant roots, as indicated by the large numbers of root hairs present and the relative scarcity of green plastids. The color of the brown mass was due to bark fragments, as indicated by the presence of corky tissue. In addition, the epidermal cells of foliage leaves were identified.—W. Robert Eadie, *Department of Zoology, University of New Hampshire, Durham, New Hampshire.*

COMPARISON OF THE PALATINE SLITS OF PITYMYS AND MICROTUS

In recent work on owl pellet remains I wished to familiarize myself with the differences between *Pitymys* and *Microtus* skulls. The anterior palatal foramina present distinct differences. I found no ready reference to these, and accordingly my observations seem worth recording.

In *Pitymys* these slits are obviously more blunt, and much more regular in their posterior terminations, neither slit extending noticeably farther than the other and neither being noticeably attenuated. *Microtus*, on the other hand, is extremely irregular in the degree and extent of posterior attenuation, seldom if ever being as blunt as in *Pitymys*. A series of measurements from 16 skulls of each type show a difference in size which also is obvious. I give the maximum, mean, and minimum of each series to the nearest tenth of a millimeter: *Microtus*,—5.8, 5.2, 4.7. *Pitymys*,—4.3, 3.9, 3.5 mm.—D. G. Nichols, *116 Ninth Street, Garden City, New York.*

A HIBERNATING JUMPING MOUSE

While digging in a sand bank, October 20, 1936, on the Edwin S. George Reserve of the University of Michigan, near Pinkney, Michigan, Lawrence Camburn, custodian, uncovered a hibernating jumping mouse (*Zapus hudsonius hudsonius*). The bank was damp and sloping, and the animal was found 2 feet 3 inches in vertical depth, and 3 feet 9 inches in horizontal depth. The spot was surrounded by open grassland, and the nearest marshy meadow was about 100 yard distant. Jumping mice usually are found in moister situations in the summer than on the relatively dry hillside in the present case. In August, 1935, two jumping mice were taken in a large marsh some distance away, and approximately 35 feet lower in elevation.

The exact construction of the nest could not be determined, since it had been broken up by the spade. It must have been of simple formation. The retrievable remains consisted of 10 or 12 small, damp elm leaves, which probably were laid in an excavation in the sand. When uncovered, the mouse was tightly rolled in a ball, with its head between its hind legs, and with the tail wrapped around the body. Approximately one-half hour after being exposed the mouse became alert and active. It seemed to be in excellent condition and was fat.

The fall had been quite mild, except for the latter part of September and the first part of October. Light frosts in the low marshy areas of the Reserve occurred nearly every night during this period, with general frosts during the nights of September 25 and October 2. The temperature reached a maximum of 75 degrees F. the day that the mouse was found. Rains had been frequent during September and October.—Arnold J. Nicholson, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

A TYPICAL SPECIMEN OF THE EASTERN ELK FROM PENNSYLVANIA

Recently, in the Proceedings of the Biological Society of Washington (vol. 48, p. 187, 1935), I described the Rocky Mountain elk as a subspecies of the eastern elk *Cervus canadensis canadensis*, and named it *Cervus canadensis nelsoni*. At that time no existing specimen of elk from eastern North America was known to me. Hence my comparisons necessarily were based on incomplete descriptions by early writers and the excellent figure by Audubon in "The Quadrupeds of North America" (vol. 2, pl. 62).

At the 1936 meeting of the American Society of Mammalogists, in Philadelphia, I learned that an old mounted specimen of a bull elk from Pennsylvania, taken in Potter County in 1853, had been dismounted, the skin tanned, and the skull roughly cleaned and placed in the study collection of the Philadelphia Academy of Natural Sciences (no. 665). Under "Donations to the Museum" (Proc. Acad. Nat. Sci. Philadelphia, vol. 7, 1856, opp. p. 454) is a note, evidently referring to this specimen: "Very fine specimen of the American Elk (*Cervus canadensis*), from Potter Co., Penna. Presented by Messrs. Vaux, I. Lea, Carpenter, Leidy, J. L. LeConte, Watson, McCall, Foulke, Cooke, Sergeant and Lambert." This is the only existing specimen of the eastern elk that I have been able to locate in any museum, or that might be considered at all typical of *Cervus canadensis canadensis* Erxleben, from "eastern Canada." It is a fully adult bull, apparently about 6 years old, with perfectly normal 6-point antlers. The skull is complete except for the loss of the basioccipital bones, destroyed in mounting. Even the two canine teeth are present, although much smaller than in most adult western bull elk. The well tanned skin evidently is somewhat faded from long exposure to the light as an exhibition specimen; but it is complete, in excellent condition, and now is hanging in a light- and moth-proof metal case where it should last indefinitely.

This specimen indicates a smaller, more slender, and more brightly colored animal than *C. c. nelsoni*. The antlers are comparatively light, with slender beams and very long, slender prongs, just as Audubon portrayed them in his colored drawing (vol. 2, p. 83, pl. 62). In addition the skull is relatively long and narrow, and in every way the specimen shows a striking resemblance to Audubon's figure of a bull elk from the western part of Pennsylvania. My notes on the color of this skin are: "Head, neck and breast bright brown; legs yellowish brown; back faded to buffy yellow; small indistinct rump patch soiled whitish." Measurements of skull: Total length, supraoccipital ridge to tip of premaxilla, 500 mm.; width over orbits, 206; postorbital width, 155; rostral width, 96; maximum width across molars, 128; alveolar length of upper molar series, 143; of lower series, 128; diastema, 73; length of hind foot, heel to tip of hoof (from tanned skin), 620; length of hind hoof, 109; width of hind foot, across both hoofs, 66 mm. Measurements checked by Remington Kellogg and J. Kenneth Doutt.

It seems important that these characters and measurements be put on record for the use of future students.—VERNON BAILEY, *1834 Kalorama Road, Washington, D. C.*

NEUROFIBROMATOSIS IN WHITE-TAILED DEER

On October 5, 1936, a female white-tailed deer was taken in the vicinity of Concord, New Hampshire. The doe was shot after she had repeatedly stumbled and had fallen into a lake. The carcass was brought to the Fish and Game laboratory for examination. The animal was normal and in good condition with the exception of a great many (226) nodulated tumorous growths distributed over the body in the following proportions: on the left side, head 30, neck 7, body and legs 59; on the right, 130. The tumors were irregular nodulated masses varying in size from 5 to 50 mm. in diameter. The external surfaces of the growths were covered with skin and the smaller growths with both hair and skin. The inner substance was made up of dense, gray-white tissue containing gray-black areas 2 to 4 mm. in diameter.

Several of the tumors were preserved in Bouin's fixing fluid and sent to the State Laboratory of Hygiene for pathological examination and diagnosis. Microscopical examination disclosed that the growths were composed of fibrous tissue that was very cellular and resembled so-called "hard-fibromas" of man, but with no definite evidence of malignancy. The black spots about the periphery were composed of keratinized epithelium surrounded by squamous epithelium of normal appearance, forming inclusion dermoid cysts. There was no evidence in this particular case that the affliction was a parasitic disease or a contagious one. It might well belong to a disease resembling Von Recklinghausen's multiple neurofibromatosis of man.

The diagnosis was made by Doctors Wm. R. McLeod and R. E. Miller. Unfortunately the internal organs of the animal were not examined.—EARL E. HOOVER, *New Hampshire Fish and Game Department, Concord, New Hampshire.*

CALL OF THE WHITE-TAIL FAWN

A voluminous literature on the habits of the white-tail deer contains astonishingly little information concerning their voice. I have not encountered any description of the use of the voice similar to that noted below.

In the early afternoon of May 31, 1936, I was passing, with three companions, along an abandoned road of the University of Michigan's Edwin S. George Reserve, a well-fenced area of 1200 acres near Pinkney, Michigan, in which deer are abundant (117 were counted in a drive, November, 1935). At a point midway between woods and open marsh I heard loud callings, frequently repeated, from varying places among the bushes near us. We continued for 100 yards in the marsh and the notes still were clearly heard. One of us, familiar with birds, first guessed the call to be that of a catbird, then a nuthatch. Its duration was intermediate between the commoner calls of these two birds, its volume greater, and the quality very different; so we returned to investigate. As a result we found two fawns, about 30 feet apart, wandering around and making the calls at intervals of about 10 seconds. Each fawn, when it became aware of our presence, dropped down to a resting position from which it would not move, and remained silent. When picked up and handled the fawns made no sound except when particularly uncomfortable, and then they uttered a protesting bleat differing from the calls heard previously. After the fawns were photographed and left they were not heard to make any further sound.

The calls of the undisturbed fawns reminded me faintly, in their tone, of the loud "ska-a-w" of an adult deer in the Adirondacks that discovered me within a dozen feet.

The small size, soft hoofs, uncertain gait, and a bloody umbilical scar of one of the fawns lead me to believe them to have been no more than 3 days old.—ROBERT T. HATT, *Cranbrook Institute of Science, Bloomfield Hills, Michigan.*

HEMORRHAGIC SEPTICEMIA IN THE BIGHORN OF ROCKY MOUNTAIN NATIONAL PARK

Previously unrecorded in the species *Ovis canadensis canadensis*, hemorrhagic septicemia has been discovered in the bighorn of Rocky Mountain National Park. The occurrence of the disease was recorded first on April 8, 1935, when a bighorn ram was found near Endovalley Campground, apparently the victim of some pneumonic condition. The lungs of this ram were taken to the Department of Veterinary Medicine, Colorado State College, and a culture was made by the Pathology Laboratory. The organism isolated from the lungs proved to be *Pasteurella oviseptícus*, the causal organism of hemorrhagic septicemia.

Again on April 10, 1936, a dead ram was found near Mary's Lake, just outside the Park boundary. Late symptoms of the disease were noted in this instance, as the ram was seen a week previous to his death. He was very emaciated at that time, hardly able

to move about, and walked with an odd, stilt-like gait. When examined, his lungs showed unmistakable signs of a pneumonic condition, with congestion and mucous in the bronchioli, bronchi, and trachea. A mucous discharge from the nostrils was noted. The ram weighed only 114.5 pounds, as compared with a possible normal weight of 200 pounds. A culture of the lungs was made at Colorado State College, and both *Pasteurella ovisepticus* and *Cornebacterium pyogenes* were revealed. Dr. I. E. Newsom, Dean of the Department of Veterinary Medicine, believes that these bacteria may be present in the normal animal, becoming active when conditions are favorable.

It was this dread malady that attacked the bison herd in Yellowstone National Park in 1911, 1919, and 1922, taking such heavy toll. Contrary to the experience in Yellowstone, where it caused the death of the younger animals of the herd, hemorrhagic septicemia so far has been noted only in adult males in the bighorn. Extremely contagious in the bison, the disease apparently does not spread rapidly through the bighorn herds, but undoubtedly is responsible for a part of the recent decrease in the bighorn population of the West.

Appreciation is expressed to Dr. I. E. Newsom for his coöperation in this work.—MERLIN K. POTTS, *Rocky Mountain National Park, Estes Park, Colorado.*

PERISSODACTYL SUBORDERS

Professor W. B. Scott has expressed a desire to follow my subdivision of the Perissodactyla into two suborders (Bull. Amer. Mus. Nat. Hist., vol. 67, p. 260, 1934) in his Part III of "The Mammalian Fauna of the White River Oligocene," but is dissatisfied with the two obsolete subordinal names, Solidungula and Tridactyla, which I revived with altered significance. Solidungula, hitherto used solely for horses, is especially unsatisfactory. At the time, I was fully conscious of the defects of these names, but preferred to modify existing names, rather than to propose new ones. These names, in their modified senses, however, are not yet fixed in the literature, and I am entirely willing to see them replaced by less ambiguous terms, compounded with "morpha" to indicate their subordinal rank. After some discussion, Professor Scott and I have agreed on "Hippomorpha" to replace my use of Solidungula, for the horse—palaeothere—titanothere—chalicothere complex, and on "Ceratomorpha" to replace my use of Tridactyla for the rhinoceros—lophiodont—tapir complex; and these two terms are hereby proposed. In some ways, Haeckel's term, Tapiromorpha, would be preferable to Ceratomorpha, except that, from 1870 to 1892, he used it in three different senses (for Palaeotherida, Macrauchenida, Tapirida, Nasicornia, and Elasmotherida; then for Palaeotherida, Tapirida, and Macrauchenida; finally for Palaeotherida and Tapirida). Thus his progressive emendations diverged farther and farther from the concept under discussion. Revival of his term, therefore, would be subject to even greater difficulties than would the use of "Tridactyla."—HORACE ELMER WOOD, 2ND, *University of Newark, Newark, New Jersey.*

BIRTH OF A MANATEE

Mr. R. J. Walters, Proprietor of the Miami Aquarium, Miami, Florida, gives the following information concerning the birth of a manatee, which took place at his aquarium several years ago. So far as I know this is the only manatee to have been born in captivity. Both parents had been in Mr. Walters' possession for several years and until a few months ago one was still alive. These notes, to be sure, are sketchy and represent observations recorded a considerable time after the event had occurred. Nevertheless, in the absence of any similar information, it seems worth while that they should be put on record. It seems quite obvious that under suitable conditions the breeding of the manatee in captivity, in Florida at least, should not present any great

difficulty. Their natural food is not difficult to secure and it is earnestly to be hoped that in the near future someone may secure a pair and record further observations. Mr. Walters' notes follow:

"One or two days before the calf was born the parent refused all food and lay very quiet. The night of the birth the parent ate freely and about five o'clock in the morning the calf arrived. It simply appeared and was there when the attendant looked in the tank. The tail was folded back on the body of the calf in the same manner that a crawfish folds up its tail and was not straightened out for some four or five hours after birth. The calf weighed 63 pounds and was 39 inches long.

"Immediately after birth the mother started slipping her flipper under the baby and raising it out of water at intervals of every three or four minutes. The male in the tank did likewise and between the two of them they had the baby getting air about all the time, so that it was necessary for us to partition the tank into two sections and separate the parents. This operation continued for approximately a week and gradually became less frequent. The calf lived in the Aquarium some eighteen months and during this time nursed. The mother became very fat before birth and lost very little of this weight after birth. After about four or five months the young calf seemed to enjoy nibbling at the grass which was fed the parents.

"During the latter part of the period when the mother was carrying the calf, a number of times during the day when coming up for air she would let out a groan as if in more or less pain. These were the only conditions that we were able to notice.

"We regret very much that the baby was killed by an accident by our night man permitting it to be taken from the tank and dropped on the floor one night, as it would have been interesting to have seen just how a manatee carried on."—Thomas Barbour, *Museum of Comparative Zoology, Cambridge, Massachusetts.*

REVIEWS

Murie, Adolph. Following Fox Trails. Miscellaneous Publication No. 32, Museum of Zoology, University of Michigan, August 7, 1936, Pp. 1–45, plates 1–6.

Our knowledge of the dietary habits of red foxes is increased considerably by this interesting paper covering observations and laboratory studies on the feeding activities of a pair of these animals on the Edwin S. George Reserve, located near Pinkney, Michigan. Not only is the report replete with field notes on habits of foxes in hunting and caching food, but it also contains valuable data on food preferences, based on the examination of a series of 768 droppings. The findings demonstrate again that the fox is a versatile animal well able to adapt itself to a great variety of food conditions, capturing when available animals as large as woodchucks, lambs, muskrats, rabbits, ruffed grouse, and chickens. The author found, as have most other investigators, that the rabbit constituted the most important single food item in the fox diet. This mammal was represented in 579 of the 768 droppings. Mice were next in importance from the standpoint of frequency of occurrence, followed by insects and birds in the order named. Birds occurred in 76 of 768 droppings, but inasmuch as specific identification of bird remains was not possible because of the fragmentary nature of the material, the author made no attempt to reach conclusions as to the significance of fox depredations on the local bird fauna except to comment that the ruffed grouse apparently had maintained their numbers in spite of the presence of the foxes, and that in recent years quail had increased on the area. Damage to birds' nests was not considered to be severe. In 103 droppings collected in May there were three occurrences of birds' eggs; in 47 in June there were four; and in 4 collected in July there was one occurrence. Although not

within the scope of the paper it would have been a profitable undertaking to determine in more detail the actual effects of these depredations.

With the contributions that to date have been made on the food habits of foxes, the reviewer feels that we now have a fair knowledge of the range of foods eaten by these animals. We know that foxes will take a great variety of vertebrate animals, many kinds of small invertebrates, many fruits and nuts, and some grains. We know that they will take game birds when available. There is much, however, that must yet be done before we have a clear picture of the rôle of these animals in our forests and fields. We need to know, for instance, with as much accuracy as possible, the effects of fox depredations on game and other wildlife populations under various ecological conditions and concentrations of predator and prey species. This will be a difficult task, and one that must be approached through detailed investigations on biologically known areas. The primary aim of future economic studies in this field should be to demonstrate what wildlife populations can be maintained in the presence of various densities of foxes. This problem is of vital and practical significance to game and wildlife technicians and it is hoped that the trend of future investigations of the food habits of foxes will be in that direction.—A. L. Nelson.

Miranda-Ribeiro, Alipio de. Didelphia ou Mammalia-ovovivipara. Revista do Museu Paulista da Universidade de S. Paulo, Tomo XX, pp. 245–428, 1936, (8 plates).

This paper is a careful presentation of the didelphids of Brazil. The author first discusses the suborders of marsupials, then treats the didelphids in general under many headings, these varying from the external characters of the family to the anatomy of the brain. This section shows a familiarity with the literature, and in consequence the citations make an excellent bibliography. A few notes on habits are included. On page 71 begins a full discussion of the genera of the Didelphidae. The classifications of Thomas, Winge, Matschie, and Cabrera are given and discussed, as is the synonomy of each genus. Like most men who have worked with the group, the author presents a key to the classification of the genera that illustrates what he considers to be the significant differences and that expresses his ideas on classification. He divides the family into 4 groups and 11 genera as follows:

SCANDENTIA
- A. Marsupiata
  - 1. Didelphis
  - 2. Metachirops
- B. Hemimarsupiata
  - 3. Metachirus
  - 4. Mallodelphis
  - 5. Caluromys
- C. Emarsupiata
  - 6. Marmosa
  - 7. Thylamis

NATATORIA
- 8. Chironectes

GRESSORIA
- 9. Lutreolina
- 10. Peramys
- 11. Minuania

This classification, although based partly on habits and upon the development of the pouch, does not differ greatly from the earlier classifications based on other characters. The reader who follows such classification as that of Herluf Winge may question the wide separation of *Chironectes* from *Didelphis* and *Metachirus*, although such separation may be justified on the basis of habits as well as upon specializations for a natatorial existence. Old females of the species *Metachirus nudicaudatus dentaneus* have a pouch that is as well developed as that of *Metachirops opossum fuscogriseus*. These points are rather minor ones to raise when discussing such an excellent paper.

Each species of marsupial that is known from Brazil is described, with measurements

and notes on geographical distribution. Under certain species critical material is discussed and the author's conclusions stated. There are described a total of 7 new species, *Marmosa meridionalis* (p. 371), *M. stollei* (p. 372), *M. blaseri* (p. 373), *M. moreirae* (p. 380), *M. herhardti* (p. 382), *Thylamis rondoni* (p. 387), *Minuania umbristriata* (p. 422); and 5 new subspecies, *Metachirus nudicaudatus personatus* (p. 351), *Mallodelphis lanigera hemiura* (p. 455), *M. l. vitalina* (p. 455), *M. l. modesta* (p. 356), and *Lutreolina crassicaudata travassosi* (p. 402).

The reviewer wishes to thank Dr. T. Barbour for bringing to his attention this valuable contribution.—ROBERT K. ENDERS.

LIST OF RECENT LITERATURE

[Conducted by Arthur H. Howell, Remington Kellogg, and Gerrit S. Miller, Jr.]

ADDE-LACOMME, JACQUELINE. Étude de l'Aceratherium de Bézac (Ariège). Bull. Soc. Hist. Nat. Toulouse, vol. 67, no. 1, pp. 76–107, figs. 9. March 30, 1935.

ADLOFF, DR. Über die Zähne von Orycteropus. Zeitschr. Anat. u. Entwicklungsgesch., Berlin, vol. 102, pp. 710–717, figs. 8. 1933.

D'AGUILLAR-AMAT, J. B. Notes mastologiques. VII. Un Quiròpter nou per a la fauna Catalana. Butl. Inst. Catalana Hist. Nat., Barcelona, vol. 34, nos. 6–7, pp. 178–179. 1934. (*Rhinolophus mehelyi carpetanus.*)

——— Notes mastologiques. VIII. El Cetacei *Tursiops truncatus* (Montg.) a Catalunya. Butl. Inst. Catalana Hist. Nat., Barcelona, vol. 34, nos. 6–7, p. 179. 1934.

AHARONI, J. Die Säugetiere Palästinas. Zeitschr. Säugetierkunde, vol. 5, nos. 5–6, pp. 327–343. December 22, 1930.

ALLEN, GLOVER M. A fruit bat, Dobsonia, new to Australia. Australian Zool., Sydney, vol. 8, pt. 2, p. 151. June 28, 1935. (*Dobsonia magna.*)

ALVING, TH. Zoologisk Have i Støbeskeen, Fortid, Nutid, Fremtid. Kjøbenhavn, pp. 206, with 303 photographs, 4 maps and plans. 1934. (Zoological garden in the melting pot, past, present, future. Fine collection of photographs.)

ANDRIANOV, K., and N. LARYN. The mode of occurrence of the bones of the upper Sarmat vertebrates of the Eldar steppe. Bull. Soc. Nat. Moscou, n. s. vol. 43, sect. geol., vol. 13, pp. 559–569, figs. 2. 1935. (In Russian, with English summary. Abundance of the upper Miocene fossil mammals.)

ANONYMOUS. Warthog (*Phacochoerus aethiopicus*). Nigerian Field, London, vol. 3, no. 1, pp. 19–23, 1 pl. January, 1934.

——— Notes on gorilla. Nigerian Field, London, vol. 3, no. 3, pp. 92–102. July, 1934. (Collection of hunter's tales.)

ANTHONY, R. Données nouvelles sur l'évolution de la morphologie dentaire et crânienne des Tubulidentata (Oryctéropes). Bull. Soc. Zool. France, Paris, vol. 59, pp. 256–266. 1934.

ASTRE, GASTON. Un suidé des marnes ludiennes de Pont d'Assou. Bull. Soc. Hist. Nat. Toulouse, vol. 66, no. 1, pp. 197–204, figs. 2. March 30, 1934.

——— Sur un Bunobrachyodus des mollasses Toulousaines. Bull. Soc. Hist. Nat. Toulouse, vol. 66, no. 2, pp. 302–308, fig. 3. August 31, 1934. (New: *Bunobrachyodus johannae.*)

——— Faune de la brèche osseuse du bois de l'hopital près de Montpellier. Bull. Soc. Hist. Nat. Toulouse, vol. 66, nos. 3–4, pp. 367–368. December 30, 1934.

BABAULT, GUY. Note sur les Boocercus du Kivu. Bull. Mus. Nat. Hist. Nat., Paris, ser. 2, vol. 7, no. 4, pp. 224–225. June, 1935.

BARBOUR, ERWIN HINCKLEY. The mandibular tusks of Amebelodon fricki. Nebraska State Mus., vol. 1, bull. 14, pp. 135–138, fig. 1. December, 1929.

——— The Milford Mastodon, Mastodon moodiei, sp. nov. A preliminary report. Nebraska State Mus., vol. 1, bull. 24, pp. 203–210, figs. 5. December, 1931. (New: *Mastodon moodiei*.)

——— The musk-oxen of Nebraska. Nebraska State Mus., vol. 1, bull. 25, pp. 211–233, figs. 15. December, 1931.

——— The articulated skeleton of a Titanotherium. Nebraska State Mus., vol. 1, bull. 26, pp. 235–238, fig. 1. January, 1932. (*Brontops dispar*.)

——— The articulated skeleton of Eubelodon morrilli. Nebraska State Mus., vol. 1, bull. 28, pp. 243–246, figs. 2. March, 1932.

——— The skull and mandible of Mastodon moodiei. Nebraska State Mus., vol. 1, bull. 29, pp. 247–250, figs. 2. October, 1932.

BEAUX, OSCAR DE. Mammiferi raccolti dal Prof. G. Scortecci nella Somalia Italiana centrale e settentrionale nel 1931. Con l'aggiunta di alcuni Mammiferi della Somalia Italiana meridionale. Atti Soc. Ital. Sci. Nat., Milano, vol. 73, no. 3, pp. 261–300, pls. 7–9. October, 1934. (New: *Acomys bovonei*, *Heterocephalus glaber scorteccii*, *Pectinator spekei legerae*.)

BENSON, SETH B. A biological reconnaissance of Navajo Mountain, Utah. Univ. Calif. Publ. in Zool., vol. 40, no. 14, pp. 439–456. December 31, 1935. (New: *Perognathus longimembris arcus*.)

BLANCHARD, FRIEDA COBB. The plant contents of two mouse storehouses. Rhodora, Jour. New England Bot. Club, vol. 37, no. 437, pp. 165–167. May, 1935. (*Peromyscus leucopus noveboracensis*.)

BOHLIN, BIRGER Kritische Bemerkungen über die Gattung Tragocerus. Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 9, no. 10, pp. 19, pls. 5. 1935.

——— Some remarks on fossil Giraffidae. Bull. Geol. Soc. China, vol. 14, no. 1, pp. 83–89, 1 pl. March, 1935.

——— Über die verwandtschaftlichen Beziehungen von Criotherium argalioides Forsyth Major. Bull. Geol. Inst. Univ. Upsala, vol. 25, pp. 1–12, figs. 6. 1935.

BOURDELLE, E. Considerations zoologiques et biologiques sur le myopotame ou ragondin. Bull. Soc. Nat. d'Acclimat. de France, Paris, 81e année, no. 12, pp. 468–478. December, 1934.

BOURNE, GEOFFREY. Glandular areas of some Australian jerboa mice, and remarks on *Nyctinomus* and *Myrmecobius*. Mem. Nat. Mus. Melbourne, no. 8, pp. 90–93, fig. 1. September, 1934.

BOURRET, RENÉ. Inventaire Général de l'Indochine. La Faune de l'Indochine. Vertébrés. Mammifères. Société de Géographie de Hanoi, fasc. 3, pp. 7–80, pls. 3. 1927. (Key to families, brief diagnoses of genera, and list of species.)

BOYER, ESTHER L. The musculature of the inferior extremity of the orang-utan Simia satyrus. Amer. Jour. Anat., vol. 56, no. 2, pp. 193–256, 15 figs. March 15, 1935.

BRAZENOR, C. W A new species of mouse, *Pseudomys* (*Gyomys*), and a record of the broad-toothed rat, *Mastacomys*, from Victoria. Mem. Nat. Mus. Melbourne, no. 8, pp. 158–161, pl. 18. September, 1934. (New: *Pseudomys* (*Gyomys*) *fumeus*.)

——— A revision of the Australian jerboa mice. Mem. Nat. Mus. Melbourne, no. 8, pp. 74–89, figs. 3. September, 1934. (New: *Notomys mitchelli alutacea*, *Podanomalus aistoni*.)

BÜRGL, HANS. Zur Frage der Schädelhaltung des Höhlenbären. Palaeobiologica, Wien u. Leipzig, vol. 5, pp. 65–80, figs. 2, pls. 2–3. 1933.

——— Morphologische und funktionelle Analyse der Wirbelsäule des Höhlenbären I. Palaeobiologica, Wien u. Leipzig, vol. 6, no. 1, pp. 65–110, figs. 7, pls. 7–8. 1934.

CALINESCU, RAUL J. Schakale in Rumänien. Zeitschr. Säugetierkunde, vol. 5, nos. 5–6, pp. 373–375, 1 map. December 22, 1930.

CASTAÑOS, E. Sobre la presencia de *Tursiops truncatus* (Montagu) en Menorca. Butl. Inst. Catalana Hist. Nat., Barcelona, vol. 34, nos. 6–7, pp. 196–197. 1934.

CASTELLANOS, ALFREDO. Las arenas del antiguo Rio Parana y la perforacion de Villa Ballester. 'Quid Novi', Rev. Asoc. Ex Alumnas y Padres Escuela Normal no. 2, Rosario, Año 2, no. 5, pp. 1–12, figs. 4. July, 1933.

CHAPPELLIER, A. Le ragondin est-il carnivore? Bull. Soc. Nat. d'Acclimat. de France, Paris, 82e année, no. 4, pp. 108–120. April, 1935. (Food of *Myocastor*.)

COLBERT, EDWIN H. Palaeotragus in the Tung Gur formation of Mongolia. Amer. Mus. Novitates, no. 874, pp. 17, figs. 7. July 24, 1936. (New: *Palaeotragus tungurensis*.)

COLEMAN-DOSCAS, A. E., and W. D'ISRAELI BIRD. Rat control in Krian, Perak. Malayan Agric. Jour., Kuala Lumpur, vol. 22, no. 4, pp. 170–176. April, 1934.

COLLIER, F. S. Notes on the preservation of the fauna of Nigeria. Nigerian Field, London, vol. 4, no. 1, pp. 3–12, January, 1935; no. 2, pp. 51–62, April, 1935; no. 3, pp. 101–113, July, 1935.

DAWSON, WARREN R. The supposed discovery of unicorns in Tibet. Proc. Linnean Soc. London, sess. 147, pt. 2, pp. 41–46. May 10, 1935. (*Pantholops* seen in profile appears to have only one horn.)

DEINSE, A. B. VAN. De walvischachtige Dieren van Nederland. Fossiele zoowel als recente. H. J. Paris: Amsterdam, pp. vii + 304, 32 pls. 1931. (The Cetacea of the Netherlands, fossil and recent.)

DOLLMAN, J. GUY. Foetal and post-natal coats of the antelopes of the subfamily Tragelaphinae. Proc. Linnean Soc. London, sess. 147, pt. 1, pp. 5–6. March 6, 1935.

DREWS, MAX. Über Ossifikationsvorgänge am Katzen- und Hundeschädel. Gegenbaurs Morphol. Jahrb. [= Jahrb. Morphol. u. mikroskop. Anat., pt. 1], vol. 73, no. 2, pp. 185–237, figs. 16. 1933.

EDGEWORTH, F. H. The cranial muscles of vertebrates. Cambridge: Univ. Press, pp. ix + 493, figs. 841. 1935 (after July, 1935).

EDINGER, TILLY. Die Foramina parietalia der Säugetiere. Zeitschr. Anat. u. Entwicklungsgesch., Berlin, vol. 102, pp. 266–289, 28 figs. 1933.

EHRENBERG, KURT. Die Plistozaenen baeren Belgiens. I. Teil: Die Baeren von Hastière. Mém. Mus. Roy. Hist. Nat. Belgique, no. 64, pp. 124, pls. 13. January 31, 1935. (New: [*Ursus spelaeus*] *nanata*.)

EISENTRAUT, M. Beobachtungen über den Winterschlaf der Haselmaus (*Muscardinus avellanarius L.*). Zeitschr. Säugetierkunde, vol. 4, nos. 4–6, pp. 213–239, 1 fig. February 10, 1930.

——— Markierungsversuche bei Fledermäusen. Zeitschr. Wissenschaft. Biol., Abt. A, Zeitschr. Morphol. u. Ökol. Tiere, Berlin, vol. 28, no. 5, pp. 553–560, fig. 1. August 11, 1934.

——— Überwinterung im Tierreich. Der Naturforscher, Jahrg. 11, no. 10, pp. 337–343, figs. 10. January, 1935. (Hibernation of hamsters, dormice, bats.)

ELDER, JAMES HARLAN. Auditory acuity of the chimpanzee. Jour. Comp. Psychol., vol. 17, no. 2, pp. 157–183, figs 4. April, 1934.

FLEURY, G. Sur le Bacille coli chez les Mammifères marins. Comptes Rendus Acad. Sci., Paris, vol. 196, no. 20, pp. 1547–1549. May 15, 1933. (*Phocaena*.)

FORMOZOW, A. N., and J. B PROSWIRNINA. L'activité des rongeurs au Caucase et leur influence sur les phytocenoses des pâturages et des prairies. Bull. Soc. Nat. Moscou, vol. 44, nos. 1–2, pp. 82–89. 1935.

FORTUNATOV, B. On the general plan of the restoration of the game fauna of the Euro-

pean part of the USSR and the Ukraine. Natur und sozialistische Wirtschaft, (Priroda i sotsialisticheskoe khoziastvo. Sbornik), vol. 6, pp. 90–109. 1933. (In Russian.)

FRASER, F. C. Zoological notes from the voyage of Peter Mundy, 1655–56. Sea elephant on St. Helena; whale at Greenwich. Proc. Linn. Soc. London, sess. 147, pt. 2, pp. 33–37, pl. 2. May 10, 1935.

FRIANT, MADELEINE. Répartition géographique et classification (d'après les caractères dentaires) des Érinacéidés fossiles et actuels. Bull. Soc. Zool. France, Paris, vol. 59, pp. 508–516, figs. 6. 1934.

——— Caractères différentiels des molaires vierges chez les porcs-epics du nouveau et de l'ancien monde. Bull. Soc. Zool. France, Paris, vol. 60, pp. 224–232, figs. 10. 1935.

——— Le nombre des incisives inférieures chez les Primates. Bull. Soc. Zool. France, Paris, vol. 60, pp. 447–450, figs. 6. 1935.

GENSCHOW, JOACHIM. Über den Bau und die entwicklung des Geruchsorganes der Sirenen. Zeitschr. Wissenschaft. Biol., Abt. A, Zeitschr. Morphol. u. Ökol. Tiere, Berlin, vol. 28, no. 4, pp. 402–444, figs. 28. May 19, 1934.

GOLDMAN, E. A. New pocket gophers of the genus Thomomys. Jour. Washington Acad. Sci., vol. 26, no. 3, pp. 111–120. March 15, 1936. (New: *Thomomys muralis, T. bottae desitus, T. b. hualpaiensis, T. b. internatus, T. b. howelli, T. b. optabilis, T. b. guadalupensis, T. lachuguilla limitaris, T. l. confinalis, T. pectoralis.*)

GROTE, HERMANN. Über die Säugetier- und vogelfauna der Gyda-Halbinsel (Nordwest-Sibirien). Zool. Garten, Leipzig, n.F., vol. 8, nos. 1–3, pp. 52–59. September, 1935.

HAMERTON, A. E. Report on the deaths occurring in the Society's gardens during the year 1934. Proc. Zool. Soc. London for 1935, pt. 2, pp. 443–474. July, 1935.

HAMLETT, G. W. D. Notes on the embryology of a phyllostomid bat. Amer. Jour. Anat., vol. 56, no. 2, pp. 327–349, pls. 2, 17 figs. March 15, 1935. (*Lonchoglossa caudifera.*)

HARLOW, H. F., and H. C. YUDIN. Social behavior of Primates. I. Social facilitation of feeding in the monkey and its relation to attitudes of ascendance and submission. Jour. Comp. Psychol., vol. 16, no. 1, pp. 171–185. August, 1933.

HAYMAN, R. W. On a new subspecies of *Mesembriomys hirsutus* from Melville Island. Ann. and Mag. Nat. Hist., London, ser. 10, vol. 17, no. 99, pp. 366–368. March, 1936. (New: *Mesembriomys hirsutus melvillensis.*)

HECHT, KÄTHE. Hermelin als Hausgenosse. Naturforscher, Berlin, vol. 12, no. 7, pp. 236–238, illus. October, 1935.

HEINTZLEMAN, B. F. Managing the Alaska brown bear. Louisiana Conserv. Rev., New Orleans, vol. 3, no. 1, pp. 5–8, 46–47, illus. January, 1933.

HEINTZLEMAN, B. F., and H. W. TERHUNE. A plan for the management of brown bear in relation to other resources on Admiralty Island, Alaska. U. S. Dept. Agric., Misc. Pub. 195, pp. 20. 1934.

HERMAN, WLADISLAW. Das milchführende Hohlrausmsystems des Ziegeneuters. Zeitschr. Säugetierkunde, vol. 5, nos. 5–6, pp. 314–326, 2 figs., 3 pls. December 22, 1930.

HERTER, K. Ueber die Verbreitung und das Verhalten europäischer Igel. Sitz.-Ber. Gesell. Naturf. Freunde, Berlin, Jahrg. 1933, nos. 8–10, pp. 340–344. December, 1934.

HILZHEIMER, MAX. Über dire neue Formen des Rentieres. Zeitschr. f. Säugetierkunde, vol. 11, pp. 154–158. March 13, 1936. (New: *Rangifer tarandus silvicola, R. t. transuralensis, R. t. dichotomus.*)

HJORT, JOHAN. Human activities and the study of life in the sea. An essay on methods of research and experiment. Geogr. Review, New York, vol. 25, no. 4, pp. 529–564, figs. 10. October, 1935.

HOPWOOD, A. TINDELL. New and little known fossil mammals from the Pleistocene of Kenya Colony and Tanganyika Territory. Ann. and Mag. Nat. Hist., London, ser. 10, vol. 17, no. 102, pp. 636–641. June, 1936. (New: *Cercocebus ado*, *Bularchus*, *B. arok*, *Hippotragus niro*.)

HORST, C. J. VAN DER. On the reproduction of the springhare, *Pedetes caffer*. South African Biol. Soc., Durban, pamphlet no. 8, p. 47. 1935.

HOSLEY, N. W., and R. K. ZIEBARTH. Some winter relations of the white-tailed deer to the forests in north central Massachusetts. Ecology, vol. 16, no. 4, pp. 535–553. October, 1935.

HOWELL, ARTHUR H. Description of a new red squirrel from Isle Royale, Michigan. Occas. Papers Mus. Zool., Ann Arbor, no. 338, pp. 2. July 7, 1936. (New: *Tamiasciurus regalis*.)

JOLEAUD, L. Les ruminants cervicornes d'Afrique. Mém. Inst. d'Egypte, Cairo, vol. 27, pp. 1–85, figs. 40. 1935.

JOLEAUD, L., and J. LOMBARD. Mammifères quaternaires d'Ounianga Kebir (Tibesti sud-oriental). Comptes Rendus Acad. Sci., Paris, vol. 196, no. 7, pp. 497–499. February 13, 1933.

KALABUCHOV, N. J. The physiological peculiarities of the mountain and plain sub species of the forest mouse (*Apodemus sylvaticus ciscaucasicus* Ogn. and *A. s. mosquensis* Ogn., Rodentia). Doklady Akad. Nauk SSSR (Comptes Rendus Acad. Sci. URSS), Leningrad, vol. 2, no. 1, pp. 82–88. April 1, 1935.

KING, HELEN DEAN. Birth weight in the gray Norway rat and the factors that influence it. Anat. Record, vol. 63, no. 4, pp. 335–354. November 25, 1935.

KIRK, JOHN C. Wild and domestic cat compared. Scottish Naturalist, Edinburgh, no. 216, pp. 161–169, figs. 3. November-December, 1935.

KLEINSCHMIDT, OTTO. Beiträge zur Naturgeschichte der Menschenaffen. Berajah, Zoographia infinita, Halle a. S., pp. 16, figs. 10, pls. 4. 1934.

KOCH, WALTER. Rudimentäre Metapodien beim Okapi. Zeitschr. f. Säugetierkunde, vol. 10, no. 1, pp. 148–150. December 31, 1935.

KOLOSSOV, A. M. Contributions to mammalian fauna of the Altai. Natur und sozialistische Wirtschaft, (Priroda i sotsialisticheskoe khoziaistvo. Sbornik), vol. 6, pp. 110–121. 1933. (In Russian.)

KORMOS, THEODOR. Knochenfragmente der in Starunia zusammen mit dem Wollnashorn gefundenen kleineren Wirbeltiere. Starunia, Polska Akad. Umiljetności, Kraków, no. 5, pp. 1–4, figs. 6. 1934.

KRIEG, HANS. Indianerhunde im Gran Chaco. Der Naturforscher, Jahrg. 11, no. 11, pp. 387–390, figs. 3. February, 1935.

KRUMBIEGEL, INGO. Literarischer Nachtrag zum Begattungsakt des Bibers. Zeitschr. Säugetierkunde, vol. 4, no. 1, pp. 33–35. July 6, 1929.

———— Notiz zur Benennung der Giraffengazelle (*Litocranius walleri* Brook). Zool. Garten, Leipzig, n.F., vol. 6, nos. 4–6, pp. 117–118, fig. 1. July, 1933.

———— Gefangenhaltung und Farbwechsel der Wiesel. Zool. Garten, Leipzig, n.F., vol. 8, nos. 1–3, pp. 8–15, figs. 2. September, 1935.

KUHN, EMIL. Die Fauna des Pfahlbaues Obermeilen am Zürichsee. Vierteljahrschrift der Naturforschenden Gesellsch., Zurich, vol. 80, pts. 3–4, pp. 241–330. December 31, 1935.

KUHN, OSKAR. Archäoceten aus dem norddeutschen Alttertiär. Zentralbl. f. Mineral., Geol. u. Paläont., Stuttgart, Abt. B., no. 6, pp. 219–226, figs. 4. 1935.

KÜHN, WOLFGANG. Die dalmatinischen Schakale. Zeitschr. f. Säugetierkunde, vol. 10, no. 1, pp. 144–146. December 31, 1935.

KURODA, NAGAMICHI. Mammals of the northern Kurile Islands. Bull. Biogeographical Soc. Japan, Tokyo, vol. 4, no. 1, pp. 47–50. October, 1933.

——— A glimpse of the animal and plant life at Shiobara, Hondo, Japan, I–III. Syokukutu oyobi Dobutu (Botany and Zoology), Tokyo, vol. 4, no. 1, pp. 71–76; no. 2, pp. 395–401; no. 3, pp. 551–560, illus. 1935–1936.

KUSJAKIN, A. P. Neue Angaben über Systematik und geographische Verbreitung der Fledermäuse (Chiroptera) der U.d.S.S.R. Bull. Soc. Nat. Moscou, sec. Biol., n.s., vol. 44, nos. 7–8, pp. 428–438. 1935. (New: *Myotis mystacinus pamirensis, M. m. aurascens, Myotis nattereri tschuliensis, Eptesicus bobrinskoi.* In Russian, with German summary.)

LANGFORD, L. J. The night life of the badger. Revealed by flashlight photography. Field, London, vol. 166, no. 4321, p. 915, illus. October 19, 1935.

LANGWORTHY, ORTHELLO R. A physiological study of the cerebral motor cortex and the control of posture in the sloth. Jour. Comp. Neurol., vol. 62, no. 2, pp. 333–348, figs. 5. October, 1935.

LARSELL, O., and ROBERT S. DOW. The development of the cerebellum in the bat (Corynorhinus sp.) and certain other mammals. Jour. Comp. Neurol., vol. 62, no. 2, pp. 443–463, pls. 3, figs. 5. October, 1935.

LASTIC, D. A. DE. Length of horns in tsine (*Bibos banteng birmanicus* Lyd.). Jour. Bombay Nat. Hist. Soc., vol. 38, no. 2, pp. 394–396. December 1, 1935.

LAURENT, PAUL. Contribution à la connaissance de la faune des Vertébrés du Maroc (Batraciens, Reptiles, Mammifères.) Bull. Soc. Hist. Nat. de l'Afrique du Nord, vol. 26, no. 9, pp. 344–359. December, 1935.

LECHNER, WILHELM. Über die ventralen Kehlkopfventrikel bei Pferd und Tapir. Gegenbaurs Morphol. Jahrb. [= Jahrb. Morphol. u. mikroskop. Anat., pt. 1], vol. 73, no. 2, pp. 289–299, figs. 6. 1933.

L[EISTER], C. W. Baby sea lion. Bull. New York Zool. Soc., vol. 38, no. 5, p. 182. September-October, 1935.

——— The anteater stretches. Bull. New York Zool. Soc., vol. 38, no. 6, pp. 219–220, illus. November-December, 1935.

LEWIS, G. EDWARD. A new species of Sugrivapithecus. Amer. Jour. Sci., ser. 5, vol. 31, no. 186, pp. 450–452, fig. 1. June, 1936. (New: *Sugrivapithecus gregoryi.*)

LOOMIS, F. B. The skeleton of a new fossil camel from Wyoming. Univ. Wyoming Publ., Laramie, vol. 2, nos. 5–7, pp. 59–64, figs. 4. May 1, 1936. (New: *Gentilicamelus, G. wyomingensis.*)

M.———, R. Red deer and chamois stalking in Austria. Field, London, vol. 166, no. 4322, pp. 962–963, illus. October 26, 1935.

MACDONALD, HENRY BAYNE. The killing of the buffalo. The Beaver, Hudson Bay Co., Outfit 266, no. 3, pp. 20–25, illus. December, 1935.

[MACDONALD, RODERICK]. Animals of the Bible. Bull. Zool. Soc. Philadelphia, vol. 10, no. 4, pp. 4. October-November, 1935.

MAC INNES, D. G. A new genus of fossil deer from the Miocene of Africa. Jour. Linn. Soc. London, vol. 39, no. 267, pp. 521–530, figs. 5. April 27, 1936. (New: *Climacoceras; C. africanus.*)

MALBRANT, R. Note au sujet de la classification des buffles africains. Bull. Mus. Nat. Hist. Nat., Paris, ser. 2, vol. 7, no. 6, pp. 320–332, fig. November, 1935.

LE MARE, G. W. R. Weights of big game. Field, London, vol. 166, no. 4316, p. 601. September 14, 1935.

MARSHALL, A. J. Notes on the habits of Australian bats. Australian Zool., Sydney, vol. 8, pt. 2, pp. 81–86. June 28, 1935.

MASLOW, A. H. Comparative behavior of Primates. VI. Food preferences of Primates. Jour. Comp. Psychol., vol. 16, no. 1, pp. 187–197. August, 1933.

MATSUURA, YOSHIO. On the breeding habits of sei whale (*Balaenoptera borealis* Lesson). Syokubutu oyobi Dobutu (Botany and Zoology), Tokyo, vol. 3, no. 5, pp. 1007–1010. May, 1935.

MATTHEWS, L. HARRISON. The oestrous cycle and intersexuality in the female mole (*Talpa europaea* Linn.). Proc. Zool. Soc. London for 1935, pt. 2, pp. 347–383, figs. 29. July, 1935.

MEINERTZHAGEN, R. Measurements of big game. Field, London, vol. 166, no. 4326, p. 1239. November 23, 1935.

MERTENS, ROBERT. Der neue Wal-Saal des Natur-Museums Senckenberg. Natur und Volk, Frankfurt a. M., vol. 65, nos. 1–12, pp. 574–586, figs. 17. December 1, 1935.

MESTRE, L. Rhinoceros brachypus de Simorre. Bull. Soc. Hist. Nat. Toulouse, vol. 66, no. 2, pp. 309–318, figs. 9. August 31, 1934.

MIDDLETON, A. D. The food of a badger (*Meles meles*). Jour. Anim. Ecol., London, vol. 4, no. 2, p. 291. November, 1935.

———— The distribution of the grey squirrel (*Sciurus carolinensis*) in Great Britain in 1935. Jour. Anim. Ecol., London, vol. 4, no. 2, pp. 274–276, map. November, 1935.

MOHR, ERNA. Die Mauleselstute im Zoo Stockholm. Zool. Garten, Leipzig, (n.F.), vol. 8, nos. 1–3, pp. 33–37, figs. 9. September, 1935.

MOORE, AUDREY. Random shots from the Serengeti. Rhino posts, overfed lions, and a leopard. Field, London, vol. 166, no. 4315, p. 549, illus. September 7, 1935.

MORALES AGACINO, E. Un nuevo Microtinae del centro de España. Bol. Soc. Española Hist. Nat., Madrid, vol. 36, no. 3, pp. 151–154. March 31, 1936. (New: *Microtus* (*Chionomys*) *nivalis abulensis*.)

MORRIS, R. C. The 'white' bison (*Bibos gaurus* H. Sm.) of South Coimbatore. Jour. Bombay Nat. Hist. Soc., vol. 38, no. 2, pp. 393–394. December 1, 1935.

———— Distribution of the hunting leopard (*Acinonyx jubatus* Erxl.) in South India. Jour. Bombay Nat. Hist. Soc., vol. 38, no. 2, pp. 386–387. December 1, 1935.

———— Social behavior of bison (*Bibos gaurus* H. Sm.). Jour. Bombay Nat. Hist. Soc., vol. 38, no. 2, p. 393. December 1, 1935.

———— A case of tiger eating salt-lick earth. Jour. Bombay Nat. Hist. Soc., vol. 38, no. 2, pp. 385–386. December 1, 1935.

MOTTL, MARIA. Wisentskelett im Museum der Kgl. Ung. Geologischen Anstalt. Földtani Közlöny, Budapest, vol. 45, nos. 10–12, pp. 363–364. December, 1935. (In Hungarian, with German summary.)

MURIE, ADOLPH. Mammals from Guatemala and British Honduras. Univ. Michigan Mus. Zool., Misc. Publ. 26, pp. 30, pl. 1, map 1. July 15, 1935.

MURIE, OLAUS J. Food habits of the coyote in Jackson Hole, Wyoming. Circular no. 362, U. S. Dept. Agric., pp. 24. October, 1935.

NEUMANN, O. Über afrikanische Wildesel. Zeitschr. f. Säugetierkunde, vol. 10, no. 1, pp. 152–153. December 31, 1935. (*Equus taeniopus*.)

NEUVILLE, HENRI. Sur quelques caractères anatomiques du pied des Éléphants. Contribution á l'étude de la formation des phanères unguéales. Archiv. Mus. Nat. Hist. Nat., Paris, ser. 6, vol. 13, pp. 111–183, figs. 53. November, 1935.

———— L'urètre glandaire des girafes. Bull. Mus. Nat. Hist. Nat., Paris, ser. 2, vol. 7, no. 6, pp. 333–339, figs. 2. November, 1935.

OEHSER, PAUL H. Homonyms and nomenclators. Amer. Midland Nat., vol. 16, no. 6, pp. 962–963. November, 1935.

O'MAHONY, EUGENE. Norwegian mice of the genera *Mus* and *Apodemus*. Meddelelser Zool. Mus., Oslo, no. 44, pp. 137–139. 1935.

OSBORN, HENRY FAIRFIELD. Des principes qui ont présidé a l'évolution biomécanique des Mammifères. Comptes Rendus Acad. Sci., Paris, vol. 196, no. 23, pp. 1760–1763. June 12, 1933.

——— Proboscidea. A monograph of the discovery, evolution, migration and extinction of the mastodonts and elephants of the world, vol. 1, Moeritherioidea, Deinotherioidea, Mastodontoidea. Publ. Amer. Mus. Nat. Hist., New York, vol. 1, pp. xl + 802, figs. 680, frontisplate. August 15, 1936. (New: *Deinotherium hopwoodi, Trilophodon hasnotensis, Tetralophodon fricki, Rhynchotherium browni, Anancus properimensis, Pentalophodon falconeri, Stegomastodon primitivus, Miomastodon depereti, Mastodon pavlowi, Mastodon acutidens, Stegolophodon lydekkeri, Stegomastodon primitivus.*)

PAINE, R. W. Observations on rat damage to coconuts on Taveuni. Agric. Jour., Dept. Agric., Fiji, vol. 7, no. 1, pp. 26–34, pl. 1. 1934.

PATTE, ETIENNE. Remarques sur l'évolution des dents molaires chez les mammifères. La Paléontologie et les grands problèmes de la biologie générale. Actualités scientifiques et industrielles, no. 176, Paris, Hermann & Cie, pp. 49, figs. 6. 1934.

PERKINS, E. A. TEMPLE. An island of death. How four elephants perished on Lake Edward. Field, London, vol. 166, no. 4324, p. 1075, illus. November 9, 1935.

PETIT, G. Description d'un crâne de Cryptoprocte sub-fossile suivie de remarques sur les affinités du genre Cryptoprocta. Archiv. Mus. Nat. Hist. Nat. Paris, ser. 6, vol. 12, pp. 621–636, figs. 7. June, 1935. (vol. 2 du Tricentenaire.) (*Cryptoprocta spelaea* Grandidier.)

——— Contribution à l'étude faunistique de La Reserve Naturelle du Manampetsa (Madagascar). Ann. des. Sci. Nat., Zool., Paris, ser. 10, vol. 18, pp. 423–481 (Mammals, pp. 474–476). 1935.

PETIT, S. C. Bandicoots attacking a cobra. Jour. Bombay Nat. Hist. Soc., vol. 38, no. 2, p. 388. December 1, 1935.

PETZSCH, HANS. Ein Fall von wirklicher Zahmheit bei einem Hamster (*Cricetus cricetus* L.). Zool. Garten, Leipzig n.F., vol. 8, nos. 1–3, pp. 25–26. September, 1935.

PHISALIX, M. Immunité naturelle du lérot commun (*Eliomys nitela* Schreb.) vis-a-vis du venin d'abeilles. Bull. Soc. Zool. France, Paris, vol. 60, pp. 235–238. 1935.

PHYTHIAN-ADAMS, E. G. The preservation of wild life in India. No. 9, Mysore. Jour. Bombay Nat. Hist. Soc., vol. 38, no. 2, pp. 241–245. December 1, 1935.

PIRILÄ, HANNES. Untersuchungen an 16 Pferdeschädeln über die Formveränderungen der Zähne und ihre Lage im Kiefer in den verschiedenen Altersstadien. Zeitschr. Anat. u. Entwicklungsgesch., Berlin, vol. 102, pp. 107–168, figs. 8. 1933.

PITT, FRANCES. The increase of the badger (*Meles meles*) in Great Britain during the period 1900–1934: with especial reference to an area in South Shropshire known as the Wheatland country. Jour. Anim. Ecol., London, vol. 4, no. 1, pp. 1–6, 1 pl., 2 maps. May, 1935.

PIVETEAU, JEAN. Études sur quelques créodontes des Phosphorites du Quercy. Ann. Paléont., Paris, vol. 24, no. 2, pp. 75–95, figs. 12. November, 1935.

POCOCK, R. I. The lion in Baluchistan. Jour. Bombay Nat. Hist. Soc., vol. 38, no. 2, pp. 381–382. December 1, 1935.

——— A pair of Indian lions presented to the British Museum by H. H. the Nawab of Junagadh. Jour. Bombay Nat. Hist. Soc., vol. 38, no. 2, pp. 382–384. December 1, 1935. (From the Gir Forest.)

——— The Asiatic wild dog or dhole (*Cuon javanicus*). Proc. Zool. Soc. London for 1936, pt. 1, pp. 33–55, fig. 1. April 16, 1936. (New: *Cuon javanicus infuscus, C. j. fumosus, C. j. laniger, C. j. jason.*)

PRAG, J. J. An abnormal baboon sacrum found at Lindeques drift. South African Jour. Sci., Johannesburg, vol. 32, pp. 356–359, fig. 1. November, 1935.

PUISSÉGUR, C. Recherches sur le desman des Pyrénées. Bull. Soc. Hist. Nat. Toulouse, vol. 67, no. 2, pp. 163–227, figs. 104, pls. 2. June 30, 1935.

PYCRAFT, W. P. Animals and perfumes. Illus. London News, vol. 187, no. 5044, p. 1126, illus. December 21, 1935.

RANKIN, NIALL. Where the grey seals breed. December on the Farnes. Field, London, vol. 166, no. 4329, pp. 1406–1407, illus. December 14, 1935. (*Halichoerus grypus*.)

RAYNER, G. W. The R. R. S. William Scoresby, 1934–35. Nature, London, vol. 136, no. 3442, pp. 630–631. October 19, 1935. (During this cruise between 700–800 whales—blue, finback, humpback, and sperm—were tagged in Antarctic seas.)

RECK, HANS. Neue Genera aus der Oldoway-Fauna. Zentralbl. f. Mineral, Geol. u. Paläont., Stuttgart, Abt. B, no. 6, pp. 215–218, figs. 2. 1935. (New: *Rhynotragus*, *R. semiticus*, *Thaleroceros*, *T. radiciformis*.)

REESE, ALBERT M. The destruction of "vermin." Science, n. s., vol. 82, no. 2138, pp. 593–594. December 20, 1935. (Protest against vermin-destruction contests.)

REINBERGER. Bastarde von Hurd und Wolf in freier Natur. Zeitschr. Säugetierkunde, vol. 5, nos. 5–6, pp. 367–369. December 22, 1930.

REYNOLDS, SIDNEY H. A monograph on the British Pleistocene Mammalia, vol. 3, pt. 4, The red deer, reindeer, and roe. Palaeontograph. Soc., London, Monogr. no. 85, pp. 46, figs. 15, pls. 3. July, 1933.

RICHARD, MARGUERITE. Fossiles de l'aquitanien moyen des Gervaises. Bull. Soc. Hist. Nat. Toulouse, vol. 66, no. 2, pp. 248–254, fig. 1. August 31, 1934.

RICHMOND, R. D. The preservation of wild life in India. No. 7, The Madras Presidency. Jour. Bombay Nat. Hist. Soc., vol. 38, no. 2, pp. 220–224. December 1, 1935.

RINTOUL, JEFFREY, and EVELYN V. BAXTER. Dolphins off the Banffshire coast. Scottish Naturalist, Edinburgh, no. 216, p. 160. November–December, 1935.

ROBERTS, AUSTIN. Mammals concerned in the bubonic plague and rabies problem in South Africa. South African Jour. Sci., Johannesburg, vol. 32, pp. 414–460. November, 1935.

ROBINSON, E. W. A preliminary experiment on abstraction in a monkey. Jour. Comp. Psychol., vol. 16, no. 1, pp. 231–236. August, 1933.

RÖHRS, HANS DIETRICH. Die Waschbärenranz. Der Deutsche Pelztierzüchter, Munich, Jahrg. 9, no. 2, pp. 34–35, illus. January 15, 1934.

ROSAHN, PAUL D., HARRY S. N. GREENE, and CH'UAN-K'UEI HU. Observations on the gestation period of the rabbit. Jour. Exper. Zool., vol. 72, no. 1, pp. 195, 212. November 5, 1935.

ROSEVEAR, D. R. The monkeys and baboons of Nigeria. Nigerian Field, London, vol. 3, no. 4, pp. 138–151, illus. October, 1934.

——— The lemurs of Nigeria. Nigerian Field, London, vol. 4, no. 1, pp. 16–21, pls. 2. January, 1935.

——— The flesh-eating mammals of Nigeria. Nigerian Field, London, vol. 4, no. 2, pp. 64–69, 2 pls. April, 1935.

——— The civets of Nigeria. Nigerian Field, London, vol. 4, no. 3, pp. 114–122, 2 pls. July, 1935.

——— The mongooses of Nigeria. Nigerian Field, London, vol. 4, no. 4, pp. 165–170, 2 pls. October, 1935.

ROWNTREE, J. B. Habits of the hog deer (*Hyelaphus porcinus* Zimm.). Jour. Bombay Nat. Hist. Soc., vol. 38, no. 2, p. 396. December 1, 1935.

RÜMMLER, H. Ueber die systematische Einteilung der afrikanischen Dornschwanzhörnchen (*Anomaluridae*). Sitz.-Ber. Gesell. Naturf. Freunde, Berlin, Jahrg. 1933, nos. 8–10, pp. 389–391. 1934. (*Anomalurus* and *Anomalurops*.)

——— Deutsche Gesellschaft für Säugetierkunde. Zeitschr. f. Säugetierkunde, vol. 10, no. 1, pp. 119–143. December 31, 1935.

RUSCONI, CARLOS. Restos humanos fósiles procedentes de la provincia de Santiago del Estero. Revista Argentina de Paleont. y Antrop., Buenos Aires, vol. 1, nos. 5–6, pp. 135–161, pls. 8. December, 1935.

SAGE, DEAN, JR. In the land of the giant panda. Field, London, vol. 166, no. 4308, pp. 138–139, illus. July 20, 1935.

SANBORN, COLIN CAMPBELL. Descriptions and records of African bats. Zool. Ser. Field Mus. Nat. Hist., vol. 20, no. 14, pp. 107–114. August 15, 1936. (New: *Rhinolophus alcyone alticolus*, *Miniopterus africanus*, *M. rufus*, *Mops angolensis wonderi*.)

SANDERSON, IVAN T. The Percy Sladen zoological expedition to the British Cameroons, 1932–33. Proc. Linn. Soc. London, sess. 147, pt. 2, pp. 25–29. May 10, 1935.

SCALON, N. N. Säugetiere des nordöstlichen Teiles des Neusibirischen Kreises. Zeitschr. Säugetierkunde, vol. 6, nos. 1–6, pp. 221–224. December 15, 1931.

SCHAEFER, HELMUT. Beitrag zur Kenntnis der Kleinsäugerfauna Tirols. Zeitschr. f. Säugetierkunde, vol. 10, no. 1, pp. 154–155. December 31, 1935.

SCHICHT, GEORG. A record stag. Field, London, vol. 166, no. 4329, p. 1421. December 14, 1935.

SCHIRMEISEN, KARL. Tierreste aus Kulturschichten des Nikolsburger Gebiets. Verhandl. Naturf. Vereines in Brunn, vol. 65, pp. 152–156. 1934.

SCHMIDT, FRITZ. Die polygame Silberfuchszucht in der Praxis. Der Deutsche Pelztierzüchter, Munich, Jahrg. 9, no. 1, pp. 2–9, illus. January 1, 1934.

SCHNEIDER, KARL MAX. Das Flehmen (III. Teil). Zool. Garten, Leipzig, n.F., vol. 5, nos. 7–9, pp. 200–226, figs. 13. October, 1932.

——— Das Flehmen (IV. Teil). Zool. Garten, Leipzig, n.F., vol. 5, nos. 10–12, pp. 287–297, figs. 2. December, 1932.

——— Über das "Drehen" der Grosskatzen. Ein Beitrag zur Raubtierzucht. Zool. Garten, Leipzig, n.F., vol. 6, nos. 7–9, pp. 173–181, figs. 9. October, 1933.

SCHOUR, ISAAC, and SHERWOOD R. STEADMAN. The growth pattern and daily rhythm of the incisor of the rat. Anat. Record, vol. 63, no. 4, pp. 325–332, figs. 4. November 25, 1935.

SCHREIBER, HANS. Zur Morphologie der Primatenhand. I. Röntgenologische Untersuchungen an der Handwurzel der Affen. Anat. Anz., Jena, vol. 78, nos. 20–24, pp. 369–429, figs. 19, pl. 1. September 24, 1935.

SCHREITMULLER, WILHELM. Zerstörung der Blüten des gefleckten Aronstabes (*Arum maculatum* L.) durch Waldspitzmäuse (*Sorex vulgaris* L.). Zool. Anz., Leipzig, vol. 111, nos. 11–12, p. 335. September 15, 1935.

SCHULTZ, A. H., and F. F. SNYDER. Observations on reproduction in the chimpanzee. Bull. Johns Hopkins Hospital, vol. 57, no. 4, pp. 193–205. October, 1935.

SCHWARTZ, R. PLATO. Observation versus measurement in fire walking. Jour. Amer. Med. Assoc., Chicago, vol. 105, no. 24, p. 2005, figs. 2. December 14, 1935. (Diagrams showing duration of weight-bearing on different parts of the sole of the foot. Successful fire walking depends on training. No reason to assume "faith.")

SCHWARZ, ERNST. On ibex and wild goat. Ann. and Mag. Nat. Hist., London, ser. 10, vol. 16, no. 94, pp. 433–437. October, 1935.

SEGUY, JEAN, and PAUL BULLIER. Recherche du cycle menstruel de l'*Hamadryas papion* L. Archiv. Mus. Nat. Hist. Nat., Paris, ser. 6, vol. 12, pp. 309–311. (volume du Tricentenaire, vol. 1). June, 1935.

SELCHOW, DON H. A strange partnership. How Mayimba, a bird, and Kambole, a honeybadger, combine their efforts to mutual advantage. Nat. Hist., New York, vol. 36, no. 5, pp. 431–437, illus. December, 1935.

SELLE, RAYMOND MARTIN LOUIS. The embryology of the thyroid, parathyroid and thymus of the Pacific pallid bat (*Antrozous pacificus* Merriam). Amer. Jour. Anat., vol. 56, no. 2, pp. 161–190, 1 pl. March 15, 1935.

SELOUS, E. M., and E. BANKS. The clouded leopard in Sarawak. Sarawak Mus. Jour., Kuching, vol. 4, no. 14, pp. 263–266, pl. 19. December, 1935.

SEREBRENNIKOV, M. K. Eversmanns Iltis (*Putorius eversmanni* Less.) in den Wermut-Steppen des nördlichen Kasakstan. Zeitschr. Säugetierkunde, vol. 4, nos. 4–6, pp. 205–212, 2 pls. February 10, 1930.

SETH-SMITH, DAVID. An okapi at the Zoo. Field, London, vol. 166, no. 4310, p. 257, illus. August 3, 1935.

——— The Zoo's okapi. Field, London, vol. 166, no. 4312, p. 385, illus. August 17, 1935.

——— Raccoon-like dogs. Field, London, vol. 166, no. 4323, p. 1030, illus. November 2, 1935. (*Nyctereutes.*)

SHELDON, H. P., and FRANK G. GRIMES. Game laws for the season 1935–36. A summary of federal, state, and provincial statutes. Farmer's Bull. no. 1755, U. S. Dept. Agric., pp. 38. October, 1935.

SHNITNIKOV, V. N. The fauna of small mammals of the valley of the Great Almatinka river, Semiretshje, Central Asia. Zashchita rastenii ot vreditelei (Defense des plantes, Bull. Bur. permanent des Congrès entomophytopathologiques de Russie), Leningrad, vol. 6, nos. 3–4, pp. 417–425. October, 1929.

SICKENBERG, O. Über *Samotragus crassicornis* nov. gen. et spec. aus dem Unterpliozän von Samos. Palaeont. Zeitschr., Berlin, vol. 18, nos. 1–2, pp. 90–94, pl. 3, fig. 1. July 20, 1936. (New: *Samotragus, S. crassicornis.*)

SIEWERT, HORST. Wie entsteht ein Geweih. Der Naturforscher, Jahrg. 11, no. 12, pp. 408–414, figs. 7. March, 1935.

SIMONS, C. W. Wild animals in their natural haunts; Kruger National Park, South Africa, the world's largest game sanctuary. Illus. London News, vol. 181, no. 4873, pls. 3–4. September 10, 1932.

SIMPSON, GEORGE GAYLORD. The first mammals. Quart. Review Biol., vol. 10, no. 2, pp. 154–180, figs. 19. June, 1935. (General account of Mesozoic mammals.)

——— An animal from a lost world. The Scarritt Expeditions unearth relics of the most ancient South American mammals in Patagonia fossil fields. Natural Hist., New York, vol. 36, no. 4, pp. 316–318, illus. November, 1935. (*Thomashuxleya.*)

SIMPSON, PAUL F. The Garrett Mastodon. Proc. Indiana Acad. Sci., vol. 43, pp. 154–155, fig. 1. April, 1934.

SMITH, J. H. The opossum in Kent County, Ontario. Canadian Field-Nat., vol. 49, no. 6, p. 109. September, 1935.

SMITH WOODWARD A. Prof. Henry Fairfield Osborn, For. Mem. R. S. Nature, London, vol. 136, no. 3446, pp. 784–785. November 16, 1935. (Obit. notice.)

SNYDER, L. L. A badger specimen from Port Dover, Norfolk County, Ontario. Canadian Field-Nat., vol. 49, no. 8, pp. 136–137. November, 1935.

SOKOLOWSKY, ALEXANDER. Hirschziegen-Antilopen als Parkwild. Kleintier und Pelztier, Leipzig, Jahrg. 10, nos. 22–24, pp. 303–305, fig. 1. December 1, 1934.

SOWERBY, ARTHUR DE C. The geological museum in Peiping. The China Jour., Shanghai, vol. 23, no. 5, pp. 297–298, figs. 2. November, 1935. (Photographs of *Cervus canadensis kansuensis, Bubalus tielhardi* [sic], *Cervus grayi, Spirocerus peii.*)

STARCK, DIETRICH, and HANS WEHRLI. Die Kaumuskulatur von *Marmota marmota* L. Zeitschr. f. Säugetierkunde, vol. 10, no. 1, pp. 33–38, figs. 5. December 31, 1935.

STEIN G. Zur Kenntnis von *Erinaceus roumanicus* B.-Hamilt. Zeitschr. f. Säugetierkunde, vol. 4, nos. 4–6, pp. 240–250. February 10, 1930.

STEJNEGER, LEONHARD. Georg Wilhelm Steller, the pioneer of Alaskan natural history. Cambridge, Mass.: Harvard Univ. Press., pp. xxiv + 623, pls. 28. August, 1936. (Includes detailed account of Bering's voyage from Kamchatka to Alaska in 1741, and a summary of Steller's observations on mammals, among them the northern sea-cow, northern sea-lion, fur seal, sea otter, arctic fox, etc.)

STEPHEN, A. C. Lesser rorqual in Aberdeenshire. Scottish Naturalist, Edinburgh, no. 216, p. 175. November-December, 1935.

——— Risso's dolphin stranded in Banffshire. Scottish-Naturalist, Edinburgh, no. 216, p. 175. November-December, 1935.

STIRTON, R. A. A new ruminant from the Hemphill middle Pliocene of Texas. Jour. Paleont., vol. 10, no. 7, pp. 644–647, fig. 1. October, 1936. (New: *Pediomeryx, P. hemphillensis.*)

ST. LEGER, JANE. Mammals from Angola, including a new species of Claviglis and a new race of Zelotomys. Ann. and Mag. Nat. Hist., London, ser. 10, vol. 17, no. 100, pp. 464–472. April, 1936. (New: *Claviglis monardi, Zelotomys shortridgei kuvelaiensis.*)

STOCK, CHESTER. A hypertragulid from the Sespe uppermost Eocene, California. Proc. Nat. Acad. Sci., Washington, vol. 20, no. 12, pp. 625–629, pl. 1. December 15, 1934. (New: *Simimeryx, S. hudsoni.*)

——— Exiled elephants of the Channel Islands, California. Sci. Monthly, vol. 41, no. 3, pp. 205–214, figs. 10. September, 1935.

——— A Pliomastodon skull from the Thousand Creek beds, northwestern Nevada. Carnegie Inst. Washington (Contrib. Palaeont.), publ. 473, pp. 35–39, pl. 1. July 10, 1936. (New: *Pliomastodon nevadanus.*)

——— Titanotheres from the Titus canyon formation, California. Proc. Nat. Acad. Sci., Washington, vol. 22, no. 11, pp. 656–661, pls. 2. November 30, 1936. (New: *Protitanops, P. curryi.*)

STOCK, CHESTER, and FRANCIS D. BODE. Occurrence of lower Oligocene mammal-bearing beds near Death Valley, California. Proc. Nat. Acad. Sci., Washington, vol. 21, no. 10, pp. 571–579, pls. 3. October, 1935.

STRAUS, WILLIAM L., JR. Note on the spinal cord of the finback whale (*Balaenoptera physalus*). Bull. Johns Hopkins Hospital, vol. 57, no. 6, pp. 317–329. December, 1935.

STROH, G. Geschlechtsunterschiede am Schambein jugendlicher Rehe. Berliner Tierärztl. Wochenschr., Jahrg. 50, no. 29, pp. 481–483, 5 figs. July 20, 1934.

——— Die Umformung der Schambeinpartie des Beckens des weiblichen Rehes unter dem Einfluss der Trächtigkeiten und des Alters. Berliner Tierärztl. Wochenschr., Jahrg. 50, no. 44, pp. 721–725, 7 figs. November 2, 1934.

STUDNITZ, G. VON. Sumpfbiber in freier schleswig-holsteinischer Wildbahn. Schriften Naturwiss. Vereins f. Schleswig-Holstein, Kiel u. Leipzig, vol. 21, no. 2, pp. 287–290. 1935.

SURGUJA, MAHARAJA OF. A short-tailed tiger. Jour. Bombay Nat. Hist. Soc., vol. 38, no. 2, pp. 384–385. December 1, 1935.

——— Sloth bear (*Melursus ursinus* Shaw) attacking a live bait. Jour. Bombay Nat. Hist. Soc., vol. 38, no. 2, pp. 391–392. December 1, 1935.

TAYLOR, WALTER P. "Man and Nature"—A contemporary view. Scientific Monthly, vol. 41, pp. 350–362. October, 1935.

TEILHARD DE CHARDIN, P., and W. C. PEI. New discoveries in Choukoutien 1933–1934. Bull. Geol. Soc. China, vol. 13, no. 3, pp. 369–389, pls. 3, figs. 9. September, 1934.

TEILHARD DE CHARDIN, P., and C. C. YOUNG. A Mongolian amblypod in the red beds of Ichang (Hupeh). Bull. Geol. Soc. China, vol. 15, no. 2, pp. 217–223, figs. 3. June, 1936. (*Eudinoceras* cf. *kholobolchiensis*.)

TETLEY, H. Gorilla skulls in the Bristol museum. Nature, London, vol. 136, no. 3442, p. 642. October 19, 1935. (Three skulls described by Prof. R. Owen [Trans. Zool. Soc. London, 1849, vol. 3, pp. 381–422, pls. 58–63.] are in the Bristol Museum.)

THOM, W. S. An elephant fight. Game and Gun and the Angler's Monthly, London, vol. 12, no. 122, pp. 660–661, illus. November, 1935.

THOMSON, DONALD F. Animals of the Australian bush. Nature Mag., vol. 26, no. 3, pp. 137–140, 189, illus. September, 1935.

TODD, T. WINGATE. The bodily expression of human growth and welfare. Science, n. s., vol. 82, no. 2122, pp. 181–186. August 30, 1935.

TOKUDA, MITOSI. An eighteenth century Japanese guide-book on mouse breeding. Jour. Heredity, vol. 26, no. 12, pp. 480–484, figs. 2. December, 1935.

TOWNSEND, M. T. Studies on some of the small mammals of central New York. Bull. New York State College Forestry at Syracuse Univ. (Roosevelt Wild Life Annals, vol. 4, no. 1), vol. 8, no. 2, pp. 120, figs. 22. December, 1935.

TROUGHTON, ELLIS LE G. A new genus and species of giant rat from the Solomons. Records Australian Mus., vol. 19, no. 4, pp. 259–262, pl. 19. September 19, 1935. (New: *Unicomys*, *U. ponceleti*.)

——— Five new rats of the genera Hydromys and Melomys from northern Australia. Records Australian Mus., vol. 19, no. 4, pp. 251–258, figs. 2. September 19, 1935. (New: *Hydromys grootensis*, *H. lawnensis*, *H. moae*, *Melomys limicauda*, *M. mixtus*.)

——— The mammalian fauna of Bougainville Island, Solomons group. Records Australian Mus., Sydney, vol. 19, no. 5, pp. 341–353. April 7, 1936. (New: *Rattus praetor mediocris*, *Melomys bougainville* [sic], *Solomys salebrosus*, *Nyctimene bougainville* [sic], *Pipistrellus ponceleti*.)

——— Descriptions of new rats and mice from Queensland. Mem. Queensland Mus., vol. 11, pt. 1, pp. 14–22. April 17, 1936. (New: *Gyomys berneyi*, *G. pumilus*, *Pseudomys minnie flavescens*, *Notomys alexis reginae*.)

TURKEWITSCH, B. G. Comparative anatomical investigation of the osseous labyrinth (vestibule) in mammals Amer. Jour. Anat., vol. 57, no. 3, pp. 503–539, pls. 1–2. November 15, 1935.

URBAIN, ACH., and P. BULLIER. Un cas de Cénurose conjonctive chez un Gélada (*Theropithecus gelada* Ruppel). Bull. Mus. Nat. Hist. Nat., Paris, ser. 2, vol. 7, no. 4, pp. 245–246. June, 1935. (*Multiceps serialis* var. *theropitheci*.)

VERLAINE, L. Le caractère analytique de la perception chez le Macaque. Bull. Cl. Sci. Acad. roy. Belgique, ser. 5, vol. 21, no. 7, pp. 744–758. 1935.

VILLALTA, J. F., and M. CRUSAFONT P. Segona nota sobre els mamífers miocènics del Vallès. Butl. Inst. Catalana Hist. Nat., Barcelona, vol. 34, nos. 1–5, pp. 128–129, pl. 8. 1934. (*Carathorhinus*, error for *Ceratorhinus*.)

VOLČANEZKIJ, I. Gefangenschaftsbeobachtungen am Steppeniltis (*Putorius eversmanni* Less.) Zool. Garten, Leipzig n.F., vol. 7, nos. 10–12, pp. 262–273, figs. 7. February, 1935.

WADE, OTIS, and PAUL T. GILBERT. The abnormal growth of the molar teeth and the

front claws of an adult pocket gopher, *Geomys bursarius* (Shaw). American Midland Nat., vol. 16, no. 6, pp. 960–964, figs. 4. November, 1935.

WAHLSTRÖM, A. Zur Frage, ob der Igel Mäuse fangen kann, Zeitschr. f. Säugetierkunde, vol. 10, no. 1, pp. 73–77. December 31, 1935.

WALKER, GEORGE. A method of numbering laboratory rats. Science, n. s., vol. 82, no. 2130, pp. 397–398, figs. 4. October 25, 1935.

WANG, KUNG-MOH. Die Fossilien Rhinocerotiden des Wiener Beckens. Mem. Inst. Geol., Nat. Res. Inst. China, Nanking, vol. 7, pp. 53–59, 3 pls. August, 1929. (New: *Dicerorhinus germanicus, D. belvederensis.*)

——— Ein Versuch zur Neugruppierung der Europaeischen Dinotherium-Arten nach den Zaehnen. Mem. Inst. Geol., Nat. Res. Inst. China, Nanking, vol. 7, pp. 60–68. August, 1929.

WARWICK, TOM. Some escapes of coypus (*Myopotamus coypu*) from nutria farms in Great Britain. Jour. Anim. Ecol., London, vol. 4, no. 1, pp. 146–147. May, 1935.

WATERMAN, A. J. Transplantation of fetal tissues between rabbits and rats. Proc. Nat. Acad. Sci., Washington, vol. 21, no. 12, pp. 635–637. December, 1935.

WEBER, AD. Funde der nordischen Wühlmaus *Microtus ratticeps* Keys. u. Blas. Zeitschr. f. Säugetierkunde, vol. 10, no. 1, pp. 150–152, figs. 2, pl. 2. December 31, 1935.

WEHRLI, HANS. Zur Osteologie der Gattung *Marmota* Blumenb. (*Arctomys* Schreb.). Zeitschr. f. Säugetierkunde, vol. 10, no. 1, pp. 1–32, figs. 24, pl. 1. December 31, 1935.

——— Die diluvialen Murmeltiere Deutschlands. Palaeont. Zeitschr., Berlin, vol. 17, nos. 3–4, pp. 204–243, figs. 7, pls. 5. December 31, 1935.

WILSON, ROBERT W. A rodent fauna from later Cenozoic beds of southwestern Idaho. Carnegie Inst. Washington (Contrib. Palaeont.), publ. 440, pp. 117–136, figs. 8, pls. 2. December, 1933. (New: *Thomomys gidleyi, Synaptomys vetus, Mimomys? parvus, Ondatra idahoensis idahoensis, Ondatra idahoensis minor.*)

——— Simimys, a new name to replace Eymysops Wilson, preoccupied.—A correction. Proc. Nat. Acad. Sci., Washington, vol. 21, no. 3, pp. 179–180. March, 1935.

——— A Pliocene rodent fauna from Smiths Valley, Nevada. Carnegie Inst. Washington (Contrib. Palaeont.), publ. 473, pp. 15–34, pls. 2. May 21, 1936. (New: *Pliosaccomys, P. dubius, Pliozapus, P. solus.*)

WISLOCKI, GEORGE B. The placentation of the manatee (Trichechus latirostris). Mem. Mus. Comp. Zool. at Harvard College, vol. 54, no. 3, pp. 159–178, pls. 7. December, 1935.

WOOD, ALBERT ELMER. Two new rodents from the Miocene of Mongolia. Amer. Mus. Novitates no. 865, pp. 7, fig. 1. June 26, 1936. (New: *Protalactaga tunggurensis, Prosiphneus lupinus.*)

——— Geomyid rodents from the middle Tertiary. Amer. Mus. Novitates no. 866, pp. 31, figs. 33. July 2, 1936. (New: *Gidleumys, G. adspectans, Pleurolicus copei, Pleurolicus dakotensis, Gregorymys* for *Entoptychus formosus* Matthew, *Gregorymys riggsi, G. douglassi, Grangerimus, G. oregonensis, Entoptychus germannorum, Dikkomys, D. matthewi.*)

——— A new rodent from the Pliocene of Kansas. Jour. Paleontology, vol. 10, no. 5, pp. 392–394, figs. 2. July, 1936. (New: *Kansasimys, K. dubius.*)

YOUNG, STANLEY P. Our Federal predator control work. Trans. 20th Amer. Game Conference, 1934, Amer. Game Assoc., New York, pp. 172–176. 1934. (Comments on use of poison by Elliott S. Barker, New Mexico State game warden.)

ZIMMERMANN, KLAUS. Zur Fauna von Sylt. 1. Säugetiere. Schriften d. Naturwiss. Ver. f. Schleswig-Holstein, vol. 21, no. 2, pp. 274–278. December 10, 1935.

——— Zur Kenntnis von Mus musculus L. Zeitschr. f. Säugetierkunde, vol. 10, no. 1, pp. 155–158. December 31, 1935.

OBITUARY NOTICES

WARREN FRANCIS EATON

Warren Eaton undoubtedly did more to arouse public sentiment in favor of the much persecuted hawks and owls than any other one individual since Dr. A. K. Fisher published his work on the food habits of hawks and owls in 1893. It was a great blow to the conservation of wild life when death took him on February 16, 1936, following an appendectomy.

Eaton was born in Weston, Massachusetts, in 1901. His hobby of bird study developed when he was a boy. Later, as a student at Harvard, this interest received added fuel and most of his spare time was devoted to it. During these years he served as secretary of the Nuttall Ornithological Club. In 1922, after graduating, he entered business in New York. Even though he devoted himself conscientiously to his occupation, his dynamic energy continued to find an outlet in his hobby. In 1931 he was elected president of the Linnaean Society, the youngest individual to head that organization.

He became the leader in organizing the Hawk and Owl Society. From his home in Upper Montclair, New Jersey, he conducted a vigorous campaign for the better understanding of the rôle of these predators in nature. In January, 1935, when the National Association of Audubon Societies established a special department concerned with the protection of predators, fish-eating birds, and other misunderstood species, Eaton gave up his business career and assumed charge. He had previously served as chairman of the Hawk and Owl Committee of the National Association of Audubon Societies. He was a real fighter with an intense interest in all conservation problems, especially the preservation of wilderness areas. He firmly believed in the ecological angle of approach as the only one satisfactory in the long run.

Eaton was a member of the American Society of Mammalogists and many of his interests and efforts were being directed toward the salvation of some of the endangered game species of mammals at the time of his death. His passing cut short a life of great promise and usefulness, but his inspiration will always remain with those who worked with him in the field of conservation.—ROGER T. PETERSON.

CHARLES EUGENE JOHNSON

Charles E. Johnson, Director of the Roosevelt Wild Life Forest Experiment Station, head of the Department of Forest Zoology of the New York State College of Forestry, died on June 6 as the result of a heart condition, the aftermath of an attack of pneumonia contracted in January.

Johnson was born in Oslo, Norway, April 24, 1880, but came to America with his parents at the age of two, and settled near the town of Warren, northern Minnesota. After graduating from Warren High School he matriculated at the University of Minnesota, and in 1912 completed his work for the doctorate. He also did graduate work one summer each at the Harvard Medical School and at the University of Wisconsin.

From 1912 to 1918 he was instructor in the comparative anatomy of vertebrates at Minnesota University, and then (1919–1920) served as assistant professor in zoology at

the University of Kansas, followed by three years as associate professor. In 1923 he was appointed professor of forest zoology at the New York State College of Forestry. In 1926 he was appointed department head of zoology and director of the Roosevelt Wild Life Forest Experiment Station. In the summer of 1931 he taught vertebrate zoology at the University of California Summer School.

Dr. Johnson's early researches were in the field of embryology and anatomy, but his interests changed to the field of vertebrate ecology about the time that he came to New York State. His monographs on the ecology and habits of the beaver and the muskrat are the most extensive as well as the most outstanding of his publications. He was a very successful photographer, and one of his important productions in this line are motion pictures of the big game animals in the Superior National Forest, taken during the summers of 1912 to 1915. These films now are in the museum at the University of Minnesota. He contributed many prize photographs at various exhibitions throughout the country, the awards having been sufficient to purchase practically all of his photographic supplies.

During his numerous and extensive trips in the field, Dr. Johnson collected a wealth of data on all forms of animal life, much of which never has been prepared for publication. He expected to do this during future years when he no longer would be able to go afield.

Dr. Johnson leaves his widow, two daughters and a brother. The latter, Dr. Arthur M. Johnson, is professor of botany at the University of California.—W. A. Dence.

COMMENT AND NEWS

John B. Semple of Sewickley, Pennsylvania, has sent us a letter written to him March 20, 1933, by I. H. Smith, who at that time was trapping in the "Barren Lands" to the westward of Churchill, Hudson Bay, in latitude 63° North, longitude 101° West. Considering the distance of this camp from any settlements or travelled routes, the notes on mammals are worth publishing. The pertinent parts of the letter follow: "A Mr. Harriss delivered your letter to me from Churchill, *via* dogs. He was 28 days from there to where our trails happily crossed. He is the first and only human being I have laid eyes on since leaving the coast. I am a trifle off the beaten trail this year, that is, I am too far east for the western natives and too far west for the eastern natives, and too far north for Chippewyans. On the whole the winter has been about the average, with the exception of February. I have lived the last 13 years on the Barrens and I must admit that the February of 1933 was in a class by itself. Beginning about the 26th of January until the 8th of March it was just simply hell. About every hour I had to break ice for dogs and self. I figure I am about 30 pounds underweight. Had about six changes of skin on face in that time. It is most remarkable how those terrific winds dry one up, and knock the skin from the face. But, strange to relate, no matter what treatment I receive from the Barrens I am always anxious to return north. The caribou are very numerous at present, in fact too much so, as they are pawing up my traps and destroying the sets. One is pleased to be amongst them and then is just as pleased to see them go. The white foxes are just about an average crop. Their fur in my estimation is a trifle better than in the two previous years. Last year the fur was disappointing, that is as to quality. This is also a poor wolf district, too far east, I presume. I shot 3 last October, and have killed 8 through trapping methods. Farther west, say about 275 miles from here, I have in past years made some big killings. About the biggest record I made was in 1927, with 92. A few interesting moments at times but it is all in the game. Killed a fairly good specimen of polar bear last fall. What she was doing this far west from coast still has me guessing, although I know they go inland to have their

cubs. If so this one was about 150 miles farther in than one expects to see or track them. Saw signs of a small one a few days later."

During the first week in January, an Asiatic Primate Expedition, under the auspices of Harvard, Bard, Johns Hopkins universities, and the Carnegie Institution, left the States for northern Siam and British North Borneo for the study and collection of primates, to be absent for at least 8 months. Included in the personnel are H. J. Coolidge, leader, A. H. Schultz, and C. R. Carpenter. In addition Wilfred H. Osgood will join the party for a part of the time. As the aims of the expedition are diverse, the members, for the most part, will work in small, separate groups. In the late summer Dr. Coolidge plans to make a survey of the wild life conditions in Java and Sumatra on behalf of the American Committee for International Wild Life Protection.

For some years, members of the Society have been enabled, through an arrangement with the publishers, to secure sets of Seton's "Lives of Game Animals" at a substantial discount. This will no longer be possible, as we have been informed that the edition is exhausted.

Doctor W. J. Hamilton, Jr., Zoological Laboratory, Cornell University, Ithaca, New York, has been investigating the numerical fluctuation of mammals, particularly of the murine species. While he has covered the literature of cyclic phenomena with care, he considers it likely that some titles have been overlooked. Accordingly he will appreciate it if authors of pertinent papers published in obscure journals, or in those with limited circulation, will communicate with him. He is also desirous of receiving unpublished field notes on the subject.

Of outstanding interest to anyone concerned over the future of our wild life and in the present actions that are so drastically and swiftly determining that future, is the paper "Rodents and Conservation" by Charles T. Vorhies in the December (1936) number of Nature Magazine. It constitutes a serious indictment of several phases of the work of the present administration as it affects wild life. Not alone is there much undesirable "control," on the part of agencies with expert advice available, of species that on the whole are beneficial, but of other agencies of the government, knowing nothing about wild life and caring less, that are engaged on a large scale in activities both wasteful of money and extremely undesirable in their ultimate results.

Doctor Vorhies recounts instances where the per-acre cost of extensive rodent control work—temporary, of course—in Arizona has been almost five times the annual rental value of the land, and on land that is persistently over-grazed. On one project it cost $47.36 to destroy the 128 jack rabbits that consume as much food as one cow, worth 20 or 25 dollars. Rodent control must, of course, be followed by predator control, to prevent damage to domestic stock by hungry carnivores, and there is no end to the vicious circle.

With the present public outlook toward wild life, fostered by years of propaganda on the part of thoughtless sportsmen and those whose jobs depend upon the continuance of this outlook, it will be a long time before our native mammals are accorded wise and proper treatment. What is even more necessary at present is some means for imposing restraint upon those public agencies who carelessly and ignorantly direct activities against wild life with results that are bound to prove irreparably disastrous.

At the present time, about 50,000 live cottontail rabbits, from Kansas and Missouri, are being liberated annually throughout the state of Pennsylvania. In addition, 3000

cottontails, from Clinton, Missouri, were liberated during December, 1936, in southern New Hampshire. This procedure, of course, is undesirable from a biological viewpoint. Diseases may be introduced and the native forms are genetically contaminated, often to a resultant disadvantage in respect to stamina. Pertinent to the former point is the fact that domesticated rabbits constitute a more likely disease hazard. In regard to the latter, it may be mentioned that the practice is firmly established, sportsmen demand, and get, more rabbits right now, and objections on theoretical grounds by biologists will have no effect whatsoever.

There are many points of interest to this problem. The introduced animals may not produce fertile offspring with the New Hampshire stock, or those escaping the hunters may not survive the rigors of the first winter. The Pennsylvania conditions offer more problems. There are three forms of cottontails in that state, and hence three different results may be encountered. Speculation will be of little avail. What is needed are facts that will be of interest alike to biologists and state game commissions. Investigations of adequate scope should be instituted in collaboration with the game officials of the states concerned.

We are confident that no individual can take the place in the collective affections of the members of the American Society of Mammalogists that is occupied by Clinton Hart Merriam. To a great many of us, in our formative period, he typified the acme of attainment in mammalogy, and there never was any question who we wanted for our first president. Throughout the history of the Society, he has been one of its most sincere friends. It is entirely appropriate that he has now become our first benefactor. Dr. Merriam has recently presented to the Society a U. S. Savings Bond in the sum of one thousand dollars. The Society is deeply grateful for this substantial indication of his regard and for the example that he has thus set.

Those submitting titles of papers for presentation at the annual meeting are requested to furnish abstracts to the Local Committee on Arrangements for the use of the local press and wire services. The wide dissemination of such items should be of benefit to the Society. Authors are assured that papers will be handled by writers experienced in the use of scientific material for news purposes.

ANNOUNCEMENT OF ANNUAL MEETING

The nineteenth annual meeting of the American Society of Mammalogists will be held at the U. S. National Museum, Washington, D. C., from Tuesday May 4, to Saturday May 8, 1937. Headquarters: Hotel Raleigh.

Titles for presentation at the meeting should be in the hands of the Corresponding Secretary, William H. Burt, Museums Building, Ann Arbor, Michigan, not later than April 15. Those submitting titles are urged to include the following information: (1) time required; (2) projection apparatus necessary; (3) if not possible to attend for the full period give days when you *will* be present.

Further details regarding the meeting may be obtained from the Corresponding Secretary or from the Local Committee on Arrangements; W. C. Henderson, *Chairman*, Victor H. Cahalane, H. H. T. Jackson, Remington Kellogg, William T. Mann, T. S. Palmer, E. A. Preble.

Back volumes of the
Journal of Mammalogy
are still available as follows:

Vol. 1. (1919–1920, 5 numbers)..	$9.25
Vol. 2. (1921).....	7.50
Vol. 3. (1922).....	12.00
Vol. 4. (1923).....	6.25
Vol. 5. (1924).....	7.50
Vol. 6. (1925).....	6.25
Vol. 7. (1926) to Vol. 17. (1936), each.....	4.00

A discount of 20 per cent is allowed to members in good standing.
There is a small surplus of several odd numbers at $1.00 each.

Monographs of the American Society of Mammalogists:

1. **Anatomy of the Wood Rat**, by A. Brazier Howell.....$1.50

225 pages, 34 line drawings, 8 color plates and three half-tones.

Members are allowed a discount of 8 per cent.

2. **The Beaver: Its work and ways**, by Edward R. Warren.....$1.00

177 pages, 78 halftones and diagrams.

3. **Animal Life of the Carlsbad Cavern**, by Vernon Bailey....$1.00

192 pages, 66 halftones, 2 maps, 1 colored.

William H. Burt, *Corresponding Secretary*
Museum of Zoology, University of Michigan, Ann Arbor, Mich.

JOURNAL OF MAMMALOGY

CONTENTS

		PAGE
Notes on the Beavers of Wood Buffalo Park	*J. Dewey Soper*	1
Notes on the Giant Panda	*W. G. Sheldon*	13
The Mammals of the Quetico Provincial Park of Ontario	*Alvin R. Cahn*	19
William H. Parkinson: California Naturalist	*Jean M. Linsdale*	30
The Wolves of North America	*E. A. Goldman*	37
Notes on the Life History of the Snowshoe Hare	*C. M. Aldous*	46
Winter Rodent Damage to Game Cover	*Hilbert R. Siegler*	57
Notes on the Life History of the Roosevelt Elk in California	*Robert T. Orr*	62
The Shoulder Musculature of the Platyrrhine Monkeys	*Berry Campbell*	66
The False Killer Whale on the North Carolina Coast	*H. H. Brimley*	71
El Valle de la Trinidad, the Coyote Poisoner's Proving Ground	*Laurence M. Huey*	74
Notes on Winter Foods of Michigan Deer	*William Johnston Howard*	77
Evening Bat Flight from Carlsbad Caverns	*Vernon C. Allison*	80
Notes on Some Mammals of Western Massachusetts	*H. E. Warfel*	82
Parturition in the Deer Mouse	*Frank H. Clark*	85
The House Rat as an Enemy of the Bank Swallow	*Dayton Stoner*	87
The Preservation of Mammal Skins in the Field	*James Lippitt Clark*	89
A New Canyon Mouse of the Genus Peromyscus from Arizona	*E. A. Goldman*	92
A New, Lower Oligocene, Amynodont Rhinoceros	*Horace Elmer Wood, 2nd*	93
General Notes		95

A Simple Method of Saving Small Mammals in the Field, *Arthur H. Howell;* *Sorex dispar* in New Hampshire, *Norman A. Preble;* Pennsylvania Records of *Sorex cinereus fontinalis*, *Earl L. Poole;* Notes on the Behavior of the California Leaf-nosed Bat, *Donald M. Hatfield;* Notes on the Big Brown Bat, *William H. Gates;* Occurrence of the Hoary Bat at Hot Springs National Park, Arkansas, *H. R. Gregg;* Killing Technique of a Weasel, *Aldo Leopold;* Fur Seals off California, *Allan Brooks;* The Food of the Fur Seal, *Franklin H. May;* A Chipmunk Captures a Mouse, *J. Kenneth Torres;* Extension of Range of *Perognathus flavus fuliginosus*, *Lyndon L. Hargrave;* *Dipodomys deserti sonoriensis* in Arizona, *G. Willett;* *Peromyscus leucopus aridulus* in Kansas, *Claude W. Hibbard;* Occurrence of the Texas Rice Rat in Oklahoma, *H. L. Whitaker;* The Cooper Lemming Mouse in Southern New Hampshire, *W. Robert Eadie;* Comparison of the Palatine Slits of *Pitymys* and *Microtus*, *D. G. Nichols;* A Hibernating Jumping Mouse, *Arnold J. Nicholson;* A Typical Specimen of the Eastern Elk from Pennsylvania, *Vernon Bailey;* Neurofibromatosis in White-tailed Deer, *Earl E. Hoover;* Call of the White-tailed Fawn, *Robert T. Hatt;* Hemorrhagic Septicemia in the Bighorn of Rocky Mountain National Park, *Merlin K. Potts;* Perissodactyl Suborders, *Horace Elmer Wood, 2nd;* Birth of a Manatee, *Thomas Barbour.*

Reviews	107
Recent Literature	109
Obituary Notices	123
Comment and News	124